

SYMPOSIUM

TISSUE ENGINEERING

A CLINICALLY RELEVANT GENE THERAPY APPROACH TO INDUCE OSTEOGENESIS: STUDY OF THE NEW GROWTH FACTOR LIM MINERALIZATION PROTEIN-3

E. Pola

Department of Orthopaedics and Traumatology, Università Cattolica del Sacro Cuore, School of Medicine (Rome-IT)

Recombinant proteins, such as the bone morphogenetic proteins have been used to enhance repair of non-union fractures and facilitate new bone formation in animal models as well as in clinical applications. However, a significant amount of recombinant BMP is required to promote osteogenesis and frequently the extent of new bone formation is low. In contrast, local gene transfer of BMPs has been shown to be more efficient in promoting osteogenesis in rodents than the use of recombinant proteins. Several different types of gene transfer techniques have been utilized for inducing bone formation. Direct injection of viral vectors, such as adenovirus, adeno-associated virus and lentivirus as well as implantation of plasmid DNA expressing BMPs or related osteogenic factors, have produced new bone in different models. However, concerns about the immune response to the viral vectors and possible dissemination of the vectors have limited the clinical use of such approaches [1]. As alternative, cell-based approaches, using cells genetically modified in culture to express an osteoinductive gene prior to implantation, have induced osteogenesis in different animal models. Gene transfer of intra-cellular proteins such as Osterix (OSX) and Lim Mineralization Protein (LMP) also have been shown to induce osteogenesis *in vivo*. The human LMP gene is alternatively spliced to produce three isoforms: human LMP-1 and LMP-3 have been shown to induce bone formation whereas LMP-2 does not exert osteogenic properties following gene transfer, but instead may inhibit osteogenesis. The mechanism through which LMP-3 [2] induces osteogenesis is still poorly defined, but appears to be mediated through the activation of genes involved in osteogenesis, including runt-related transcription factor 2 (RunX2), Osterix (OSX) and certain BMPs. We previously have demonstrated that adenoviral gene transfer of human LMP-3 (Ad.hLMP-3) facilitates ectopic bone formation; however, concerns about the dissemination of the adenoviral vector have prevented the clinical application of Ad.LMP-3. Thus, in order to develop a clinically relevant gene therapy approach to facilitate bone healing, we have used primary dermal fibroblasts transduced *ex vivo* with Ad.LMP3 and seeded on a hydroxyapatite/collagen matrix prior to autologous implantation. The genetically modified autologous dermal fibroblasts expressing Ad.LMP-3 are able to induce ectopic bone formation into the mouse triceps and paravertebral muscles and to heal efficiently rat bone critical size defect model as determined by X-ray, histology and three dimensional micro computed tomography (3D μ CT). Our data [3] demonstrate the effectiveness of the non-secreted intracellular osteogenic factor LMP-3 in inducing bone formation *in vivo*. Moreover, the utilization of autologous dermal fibroblasts implanted on a biomaterial represents a promising approach for possible future clinical applications aimed at inducing new bone formation.

References

1. Pola E, Lattanzi W, Pecorini G, Logroscino CA, Robbins PD (2005) Gene therapy for *in vivo* bone formation: recent advances. *Eur Rev Med Pharmacol Sci* 9(3):167–174
2. Pola E, Gao W, Zhou Y, Pola R, Lattanzi W, Sfeir C, et al (2004) Efficient bone formation by gene transfer of human LIM mineralization protein-3. *Gene Ther* 11(8):683–693
3. Lattanzi W, Parrilla C, Fetoni A, Logroscino G, Straface G, Pecorini G, Tampieri A, Bedini R, Pecci R, Michetti F, Gambotto A, Robbins PD, Pola E (2008) *Ex-vivo* transduced autologous skin fibroblasts expressing human Lim Mineralization Protein-3 efficiently form new bone in animal models. *Gene Therapy* [Epub ahead of print]

TYPE-I COLLAGEN MEMBRANE AS A SCAFFOLD FOR TENDON REPAIR: AN IN VITRO AND IN VIVO STUDY

A. Gigante, E. Cesari, A. Busilacchi, S. Manzotti, F. Greco

Department of Orthopaedics, Polytechnic University of Marche (Ancona-IT)

Objective Bioscaffolds have been proposed as alternatives to auto-, allo-, xeno- and synthetic grafts in tendon and ligament repair and substitution. A new type-I collagen membrane developed for use as a tendon graft was tested *in vitro* and *in vivo*.

Material and Methods The membrane (Opocrin - Modena, Italy) is obtained from type-I collagen harvested from equine Achilles tendon and is composed of collagen I fibres oriented in a single direction. Its is isotropic, due to its microlaminated and multilayered parallel structure. The raw material is carefully processed and results in a biocompatible, non-reactive, non-antigenic and non-immunogenic acellular membrane that is resorbable and hygroscopic and can be produced in a range of thicknesses and collagen concentrations. In addition, it does not contain elastin, which may elicit inflammatory reactions.

In vitro study. Primary human fibroblast cultures were established and characterized using anti-collagen I and anti-fibronectin monoclonal antibodies. They were seeded at a concentration of 50,000 cells/cm² on collagen I membranes with aligned fibres (material # 40133) with and randomly arranged fibres (# 40153). Cell proliferation was evaluated at 4, 8 and 12 days by spectrophotometry using an MTT colorimetric reaction. Membrane sections were studied by immunohistochemistry (anti-collagen I and anti-fibronectin monoclonal antibodies) and observed with a confocal microscope on day 12 of culture.

In vivo study. The middle third of the patellar tendon was lesioned bilaterally in 10 adult male New Zealand White rabbits and repaired on the right side by a graft (# 40133). The contralateral tendon was left untreated and served as control. Animals were euthanized 1 or 6 months after surgery and the tendon grafts subjected to histological examination.

Results The *in vitro* study demonstrated cell viability and proliferation already on day 4 from membrane seeding, and maintenance of the fibroblastic phenotype until the 12th day. Confocal microscopic observation showed that cells were homogeneously distributed in all membrane specimens, with a more marked orientation along the main membrane axis in batch 40133 than in # 40153. The *in vivo* study one month from implantation showed well-differentiated cell growth into the membrane. At 6 months

cell orientation and differentiation in the scaffold with aligned fibres was satisfactory, with decreased cellularity, good integration with the surrounding tissue and crimps. Inflammatory reaction, plasma-cell infiltrate or excessive implant neovascularization were never observed.

Discussion The new type-I collagen membrane exhibited a behaviour similar to other tendon or ligament scaffolds both in vitro and in vivo. Orientation in the scaffold with aligned fibres allowed obtaining a quick and well-oriented cell growth as well as good integration with host soft tissues. The membrane appears to be suitable for application in tendon and ligament reinforcement.

Suggested reading

1. Fini M, Torricelli P, Giavaresi G, Rotini R, Castagna A, Giardino R (2007) In vitro study comparing two collagenous membranes in view of their clinical application for rotator cuff tendon regeneration. *J Orthop Res* 25(1):98–107

ONE STAGE OSTEOCHONDRAL REPAIR WITH AUTOLOGOUS CARTILAGE FRAGMENTS IN A HYBRID SCAFFOLD: IN VITRO AND IN VIVO ANIMAL MODEL

P. Rossi¹, A. Marmotti¹, F. Castoldi¹, R. Rossi¹, M. Bruzzone¹, G. Tarone², B. Peirone³, M. Mauthe Von Degerfeld³

¹Department of Orthopaedics and Traumatology, Mauriziano "Umberto I" Hospital, University of Turin (Turin-IT); ²Department of Genetics Biology and Biochemistry, MBC, University of Turin (Turin-IT); ³Department of Animal Pathology, University of Turin (Turin-IT)

Objective Articular cartilage lesions are a common problem in orthopaedics; different surgical procedures have been developed to enhance repair of articular cartilage defect. One stage cartilage repair is a promising approach; delivering viable cell source in a scaffold without *ex vivo* cell expansion, repair process is promoted without patient's exposure to multiple procedures and *ex-vivo* cell-scaffold preparation. Our study shows a new "one-stage" surgical procedure for cartilage repair combining *in situ* minced autologous cartilage fragments, as source of viable cells and chondrogenic stimuli, with a resorbable scaffold composed of fibrin glue and high-molecular-weight hyaluronic acid derivative (HA).

Material and Methods *In vitro*, cartilage explants from rabbit and goat knees were minced and loaded onto the scaffold; constructs were cultured in growth medium for 1 and 2 months. The same procedure was performed on human cartilage explants (young and late adult patients). In experimental rabbit model, large full thickness chondral defects were created in trochlea of 24 N.Z. white adult rabbits; defects were either treated with cartilage fragments embedded in the scaffold or loaded with scaffold alone or left untreated. Animals were sacrificed at 1 months, 3 months, 6 months. Repair process was evaluated with gross morphological and histological analysis (hematoxylin and eosin, Alcian blue, immunohistochemistry for collagen type 2).

Results Goat, rabbit and human chondrocytes outgrowth from cartilage fragments into the scaffold was demonstrated in vitro in cartilage explant cultures. Repair process of *in vivo* rabbit model showed improved cartilage healing of treated defects, compared to scaffold alone, and presence of collagen type II in the treated defects.

Discussion and Conclusions This study suggests that autologous cartilage fragments embedded in our HA/fibrin resorbable scaffold provide a viable source of cells and chondrogenic stimuli for a one-stage non-culture based repair of full-thickness articular cartilage defects.

ORAL PRESENTATIONS

HIP

FIRST HIP PROSTHESIS WITH CERAMIC-CERAMIC COUPLING AND HYDROXYAPATITE COATING

F. Trentani, P. Trentani, O. Moreschini

Rizzoli Orthopaedic Institute (Bologna-IT)

Objective In 1971 a group of Bolognese researchers, Trentani, Paltrinieri, Cini, Sandolini and Pizzoferrato, each with specific tasks, wanted to reassess prosthesis fixation to the bone.

Material and Methods Considering the excellent but risky results of cement introduced by Charnley, they performed experimental studies on laboratory animals to assess the concept of bone-prosthesis integration and extend studies begun by Boutin on ceramic materials. These studies showed that bone trabeculae formed on ceramic materials that perfectly adhered to their surface and they concluded that such materials can have a wide application in orthopedic surgery since they are electrolytically inert in our tissues and their physical-chemical constitution is very similar to that of bone. Therefore, they developed an prosthesis with a polyethylene acetabular cup and ceramic-coated titanium stem, realized by spraying alumina at temperatures of 100,000°C with the plasma-Jet technique.

Results The long-term results at 2 years on 8 patients aged between 63 and 74 years were encouraging and prompted further studies and an Italo-Austrian collaboration, where total joint arthroplasty with ceramic-ceramic coupling was developed in 1975. The stem was made of titanium coated in hydroxyapatite by chemical bonding, with the plasma-jet technique realized at the Rizzoli Orthopedic Workshops. The acetabular cup was a single block with 3 fixation spikes and the femoral head was also a single block of alumina; both the latter components were manufactured by the German company Rosenthal, Lauff. The follow-up at 6 years of the 5 patients treated shows an identical clinical and radiographic pattern: the bone-prosthesis contact shows the formation of tight bond and no radiotransparent line; the cortices show no periosteal reactions, a sign of load concentration; the modest wear between the ceramic surfaces did not cause the formation of foreign body granulomas, thus showing the non-toxicity of the material.

Discussion These studies highlight some fundamental aspects that now we adopt: the integration between bone and ceramic material, stability of the implant and ceramic-ceramic coupling, and functionality and survival of the implant.

Conclusions The authors concluded that thanks to the use of ceramic materials it will be possible to lower the mean age of implanting a prosthesis and new techniques of bone fixation and bone substitution can be developed; today we can support this forecast.

THIRTY YEARS OF EVOLUTION OF THE MODULARITY IN THE ARTICULAR PROSTHESIS

C. Callea

Casa di Cura Giovanni XXIII, Monastier (Treviso-IT)

Nowadays the modularity is widely used in joint prosthesis, especially in hip and knee. Usually, the aims of the modularity are: to compose during surgery, the most appropriate implant according to the anatomic-pathological conditions of the patient; to make the surgical technique much easier; and, to be able to assemble components of different materials. These concepts were developed 30 years ago when the MC (Motta-Callea, 1978) knee prosthesis was designed and manufactured by Lima-Lto. The MC is the first mod-

ular knee prosthesis where the articular components are connected by a conical coupling to the intramedullary stems which are previously screwed into the bone. This kind of modularity gives several advantages, such as: the freedom to choose the rotation of the articular components; the chance to achieve the required joint tension independently of the tibial liner thickness; and, the extreme easiness in performing the bone cuts, due to the fact that the resection masks are fixed to the stems, guaranteeing primary fixation of the implant, even in cases of severe laxity and poor bone trophism. One year later in 1979, the modularity between articular component and intramedullary stem was also applied to the hip prosthesis, the model was named MCL (Motta-Callea-Lualdi, Lima-Lto). The MCL is the first modular prosthesis where the required length of the neck can be chosen regardless on the stem size. During the same period Lima-Lto designed the first titanium acetabular cup able to host the polyethylene liner through a conical connection. As of today no cases of dislodgement or motion of the liner have been found and, the analysis of 40 retrieved liners performed twenty years later (1989) have shown no signs of backside wear, thus confirming the excellent reliability of the conical coupling. As a matter of fact, the conical coupling between liner and cup is the system still applied for the metal and ceramic liners, in addition to the polyethylene liners. Thanks to the experience acquired, during the '80s and '90s the conical coupling was used in several prosthetic systems for the shoulder, the knee and the hip, primarily for cases of hip dysplasia, revision and tumor. Particularly, in the mid '90s, a system for hip revision was designed, characterized by the possibility of obtaining the required length of the modular stem, regardless of the level of fixation of the distal part (Revision System, Lima-Lto).

APPLICATIONS OF HYDROXYAPATITE IN FIXATION OF ORTHOPAEDIC DEVICES

G. Zarattini, U.E. Pazzaglia

Orthopaedic Clinic, University of Brescia (Brescia-IT)

Hydroxyapatite coating has been widely employed in orthopaedic surgery to improve bone on-growth on metallic surfaces. This target has been retained relevant for prosthetic components fixation but also for external fixators. An experimental study was carried out in the femur of rats with intramedullary rod of pure titanium and other coated with hydroxyapatite. Undecalcified, plastic embedded section were performed in transverse planes of the diaphysis and the cellular aspects of the bone interface with titanium and hydroxyapatite were compared. The artifacts due to technical procedure for the specimens preparation can influence the evaluation of the bone. Substrate contact area, however even within these limits it was possible to demonstrate do oppose bone matrix only on the hydroxyapatite substrate. Stable fixation can be obtained also by metal surface implanted into the bone, but the cell behavior is different than with the hydroxyapatite surface.

Suggested readings

1. Pazzaglia UE, Bernini F, Zatti G, Di Nucci A (1994) Histology of Metal-Bone Interface: Consideration about interpretation of plastic embedded slides. *Biomaterials* 15:273-277
2. Pazzaglia UE, Chiesa R, Andrini L, Zatti G (1996) Comparative study of HA and Ti-coating fixation of cementless stems and the relative weight of mechanical stability. *Acta Orthop Scand Suppl* 272, 67:116
3. Pazzaglia UE, Brossa F, Zatti G, Chiesa R, Andrini L (1998) The relevance of hydroxyapatite and spongy titanium coatings in fixation of cementless stems. An experimental comparative study in rats femur employing histological and microangiographic techniques. *Arch Orthop Trauma Surg* 117:279-285

CERAMIC-ON-CERAMIC COUPLING WITH 36 mm HEADS

R. Giacometti Ceroni, M. Corbella, C. Pagnuzzato, L. Zagra

I Divisione, Istituto Ortopedico Galeazzi, IRCCS (Milan-IT)

Introduction In alumina-on-alumina THA, the head diameter raise does not increase in a considerable way neither the wear rate nor the friction torque. A bigger diameter leads to a more stable joint and to a wider ROM. 36 mm is the best compromise between the diameter of the head and the safe of the liner.

Methods We implanted more than 600 cases of 36 mm ceramic-ceramic THA since 2001. No breakage of the liner nor of the ball, no squeaking, few cases of temporary instability have been observed. A prospective study was performed to investigate the dislocation rate in the first two years postop. We matched two groups of patients, comparable in diagnosis and age: the first one (370 cases, March 2001–March 2004) in which 36 mm heads were implanted, the second one (223 cases, January 2001–March 2004) in which 28 mm were used. The surgical technique (postero-lateral approach), the surgeons and the stems were the same. We compared the number of dislocations in the two groups.

Results There were 4 dislocations (1.08%) in the first group and 10 (4.48%) in the second with a statistically significant decrease in the 36 mm ($p = 0.011$ -Fisher's exact test). The recurrent dislocations that needed a revision were: one in the 36 mm group (0.27%) and 3 in the 28 mm group (1.34%), confirming the lower rate in the bigger heads.

Conclusions Our data confirmed that there is no difference in the rate of complications and a statistically significant decrease in the dislocation rate with no late dislocations in the 36mm heads.

MODULARITY IN REVISION CUP

F. Biggi, S. Di Fabio, S. Trevisani

UOA di Ortopedia e Traumatologia, Ospedale San Martino (Belluno-IT)

Total hip arthroplasty remains one of the most successful and reliable surgical procedure to relieve pain and improve function. Despite the overwhelming success of this operation, there are instances such as aseptic loosening, septic loosening, recurrent dislocation and periprosthetic fractures where a revision is required. The choice of implant for acetabular reconstruction or substitution is based largely upon the amount of bone loss as evaluated in the pre-operative plan, usually on plain X-ray or CT scan, and at the time of revision surgery. Component selection is influenced by the surgeon's experience, literature dates and market options. It seems that state of the art has become an hemispherical ingrowths shell, supplemented with bone graft to fill contained and non structurally essential defects. Alternatives include the use of a cemented all-poly component, impaction grafting and the use of a cemented all-poly cup, elliptical or bilobed cup, reconstruction ring or cages. Revision cup modularity is a new suitable option for acetabular revision surgery: the Delta Revision Cup (Lima LTO) allows the surgeon to create different configurations during surgery facing morphology and bone loss simply utilizing a cranial modulus that modifies the cup geometry from hemispherical to oblong, inserted in three different cup areas corresponding to the major cavity deformation. Furthermore, after shell insertion internal components allow correct inclination and antiversion. Looking at different bone loss degree, the system provides a cup with multiple holes

for screw fixation, a medial obturator hook and three lateral flanges for iliac fixation for severe bone loss and pelvic discontinuity; and a cup with multiple holes and no hook or flanges for more simple cases. The two cups are TT (Trabecular Titanium) manufactured: this material enhances primary stability because the high friction moment, as well as secondary bone ingrowths because the high biocompatibility, permitting revision surgery in elderly patients. Different coupling and diameters are possible, from metal-high density polyethylene to ceramic-high density polyethylene, to ceramic-ceramic and finally metal on metal. Clinical use started recently in three pilot centres, and procedures have been performed: we had no intra-operative complications, mobilization started in 3–5 days in all patients and no early loosening or implants modification was noted at conventional X-ray evaluation. One complication occurred: a dislocation due to mobilization of polyethylene insert.

ALUMINA AND ZIRCONIA CERAMICS: IN VITRO AND IN VIVO BIOCOMPATIBILITY AND ANALYSIS OF MECHANISMS OF CLINICAL FAILURE

G. Maccauro, C. Piconi, M. Angeloni, G. Magliocchetti Lombi

Università Cattolica del Sacro Cuore (Rome-IT)

Aim Ceramic materials are currently used in Orthopaedics and Dentistry in younger patients with longer life expectancy, for the high biocompatibility of these materials, in particular Alumina and Zirconia. Up to now Zirconia is no more used in Orthopaedic for the risk of fracture. The aim of the study was to analyze the biological properties of these materials, focussing on in vitro and in vivo biological response and possible mechanisms of failure.

Material and Methods *In vitro* tests were performed measuring the human lymphocytes mitogenesis of cells coming from peripheral blood of healthy volunteers in contact with ceramic powders. In the in vivo tests cylinders of different ceramic materials were inserted into surgical created defect of proximal metaepiphysis of New Zealand White adult rabbits to analyze the bone response to ceramics. Percentage of bone ceramic contact was measured. Massive inflammatory response was analyzed by intraarticular injection of powders of different materials; while chronic low grade response as the one observed in long term well functioning implants was tested by implantation of low cohesive ceramic pellets under patellar tendons of rabbits: thank to leg movements few particles were released in time. Systemic host response was tested analyzing peripheral organs of animals. Alumina and Zirconia ball heads retrieved from failed implants were tested using SEM and mechanisms of failure were reported especially in case of ceramic fracture.

Results Ceramics did not negatively influenced cell proliferation. Connective tissue was present at bone ceramic interface whatever materials used: no statically differences were observed in term of bone ceramic contact among Alumina, Zirconia. Inflammatory response with new vessels was observed around powders, especially with small diameter; while low cohesive pellets did elicited neither inflammatory response nor systemic toxicity. Analysis of fracture of ceramic ball heads has been reported, demonstrating that in case of Zirconia fracture, the mechanism of failure is not related to the material.

Discussion and Conclusions Our results confirm that Alumina and Zirconia ceramics, induces a low inflammatory reaction in periprosthetic tissues without any systemic toxicity, due to massive or chronic release. So thank to their good mechanical properties they are still indicated and so Zirconia ceramics should be again considered in Orthopaedic Surgery.

PEDIATRIC ORTHOPAEDICS

ORTHOPAEDIC MANAGEMENT IN CEREBRAL PALSY: 25 YEARS OF ROMAN SCHOOL EXPERIENCE

C. Villani, P. Persiani, I. Molayem, L. Romanini

Dipartimento di Scienze dell'Apparato Locomotore, Università degli Studi "La Sapienza" (Rome-IT)

Cerebral palsy (CP) is a pathology characterized by a non progressive lesion of the central nervous system during its development, which is followed by peripheral manifestation that worsen with time. The roman school of orthopaedic, since its origins, has focalized on paediatric pathologies; in 1984, from the daily collaboration of one of its members, Luigi Romanini, and the neurologist Giorgio Sabbadini, the monograph "Indication for cerebral palsy orthopaedic surgery" was born, expression of a new approach to CP. The collaboration between rehabilitators and orthopaedic was highlighted: surgery is just part of a more complex management and it is necessary only if conservative treatment is not sufficient to obtain improvement or to maintain previous achievements. Surgery becomes then function-oriented, preceding in proximo-distal direction and on multiple levels. Furthermore, a classification of the lower limb spastic form based on two varieties split in phases was introduced: this is the basis for guidelines in order to uniform surgical treatments, at today, still a problem for those who approach CP. At last, the outcome of these 25 years of experience in orthopaedic CP management is analyzed.

EXTRACORPOREAL SHOCKWAVE THERAPY (ESWT) AND BOTULINUM TOXIN FOR LOCAL TREATMENT OF THE SPASTICITY IN CHILDREN WITH CEREBRAL PALSY: EVALUATION OF RESULTS WITH THREE-DIMENSIONAL GAIT ANALYSIS

C. Servodio Iammarrone, F. Servodio Iammarrone

Cattedra di Medicina Fisica e Riabilitativa, Università degli Studi di Napoli "Federico II" (Naples-IT)

Spasticity is a chronic motor disorder caused by upper motor neuron lesion, and is characterized by a velocity dependent increase in tonic stretch reflex (muscle tone), with exaggerated tendon jerks resulting from hyperexcitability of the stretch reflex, and abnormal limb posture. According to Lance, the four distinguishing features of the upper motoneuron syndrome are the positive symptoms of enhanced stretch reflexes (spasticity) and released flexor reflexes in the lower limbs; and the negative symptoms of loss of dexterity and weakness. In patients with upper motor neuron lesion, the clinical problems of movement dysfunction arise from a complex interaction among positive symptoms, negative symptoms, and changes in the physical properties of muscle and other tissues cronicly subjected to positive and negative behaviors. In the cerebral palsy (CP) the muscle shortening, arising as a consequence of the spasticity, leads to deformity. The most common pattern of spasticity in the lower limb involves adduction at the hip joint, extension or flexion at the knee and plantarflexion at the ankle. Spasticity impaired mechanisms of movement production, muscle stiffness, and contracture all contribute to an imbalance of forces affecting joint position statically and limb movement dynamically. Stiffness and contracture involve the "rheologic" properties (plasticity and viscoelasticity) of muscle and tendons. When considering contractures in CP we can categorise the contractures as having dynamic (i.e., neurological) and fixed (i.e., anatomical) components. Only chil-

dren with muscle shortening due to dynamic contracture respond largest to focal treatment of spasticity.

Focal treatment of spastic muscles by chemodenervation using botulinum toxin plays an important role in the management of spasticity in the cerebral palsy. In the past 10 years Extracorporeal Shockwave Therapy (ESWT) has also been described for the effective treatment of the muscular dynamic contracture caused by spasticity [1, 2]. Mild spasticity can often be treated successfully with a combination of range of motion (ROM) exercises, splinting, orthotics and botulinum toxin intramuscular injections or ESWT focal treatment. Patients with significant spasticity, however, may not respond to conservative management and may require more aggressive measures to produce a significant change in function. In our study we observed that sometimes the equinus foot deformity due to severe plantar flexion contracture doesn't respond to stretching, bracing and to single intramuscular injections botulinum toxin or ESWT focal treatment. In these cases, we have often used successfully a combination of botulinum toxin and ESWT to reduce the muscular contracture and improve ability. If plantarflexor spasticity continues to be a problem, the patient will be a candidate for a tendo-Achilles lengthening at a later date. Spasticity in fact may interfere with voluntary movement and self-care, minimizing it may enhance the patient's ability to achieve specific functional goals. The positive results of this management improve the functional ability. Appropriate orthotics, physical therapy, and a home maintenance program maximize the effects of this combined treatment. The physical rehabilitative program post treatment consisted of: immediate stretching exercises for the plantiflexors, to improve dorsiflexion ROM; facilitation of the ankle dorsiflexors, to increase strength and selective control; strengthening of the quadriceps and hip extensors, and stretch calf muscles; gait training to promote the ambulation control. We have used three-dimensional gait analysis and functional health assessment with specific scales to evaluate the outcome of therapeutic interventions in children with cerebral palsy.

References

1. Servodio Iammarrone C et al (2002) Shock Waves in management of spastic equine foot. Eastern Mediterranean Cerebral Palsy and Developmental Medicine Congress. Turkish Journal of Physical Med and Rehabil 59
2. Servodio Iammarrone C et al (2002) ESWT in management of equine foot deformity in children with cerebral palsy. Atti 5th Congress of the International Society for Musculoskeletal Shockwave Therapy (ISMST) 10

PRENATAL DIAGNOSIS IN ORTHOPAEDICS

G. Pagnotta, D. Mascello

Department of Orthopaedics, Bambino Gesù Pediatric Hospital (Rome Palidoro-IT)

Objective To investigate the effectiveness on sonographic prenatal diagnosis in skeletal diseases and to evaluate the utility of prenatal diagnosis in early management after birth.

Material and Methods From January 1996 to December 2007, 588 pregnant women carrying fetuses affected by skeletal malformations have been investigated by a panel of physicians including gynaecologist, orthopaedic, paediatrician. Obstetric nurses in a first level centre on prenatal diagnosis. The time of first observation is performed at the 15th week of gestational age by mean vaginal probe. At 22nd week a morphologic evaluation has carried out especially referred to bone diseases at the age detectable because of the complete skeletal ossification. At the 32nd week a last sonography is performed to evaluate the foetus positioning.

Results Clubfoot is widely the most frequent skeletal disease detected in pregnancy. In our series it has been reported in 216 pregnant women. The sonography has not been able to differentiate light, mild and severe type. Skeletal dysplasia have been diagnosed in 180 patient after measurement of tubular bones (femur and humerus) of carried foetus. Spina bifida, congenital spine deformity as scoliosis and kyphosis have been found in 82 women. Long bones deformities as short femur, tibial and/or peroneal hypoplasia, congenital bowing of tibia have been detected in 68 women. Pathologies due to amniotic band with late intrauterine amputation have been diagnosed in 28 pregnant women. In 14 women miscellaneous of minor skeletal pathologies have been detected.

Discussion The clubfoot diagnosis in pregnancy from 16th to 28th week is not difficult and the amount of amniotic fluid enhances his detection. This is not so easy during the last period of pregnancy and in that gestational age the presence of clubfoot could be missed because of the inverted ratio foetus-amniotic fluid. The spine deformities, like congenital kipo-scoliosis, are usually suspected because of lack of movement of spine in lateral plane when the foetus is elicited to move with a gentle bump on mother's abdomen. The prenatal diagnosis of skeletal dysplasia could create any difficulties in detecting achondroplasia as well. The length of tubular bones (femur and humerus) result normal until last trimester of pregnancy and the growth delays from 31st-32nd weeks of gestational age as largely described by various authors and that could reduce the therapeutic options.

Conclusions Prenatal sonographic diagnosis in uterus is largely useful in detecting skeletal anomalies in foetus because of is early ossification. The early diagnosis of bone diseases could offer a wide choice of therapeutic options and could help surgeon in managing the deformity.

CHANGES IN BONE METABOLISM DURING GROWTH

R. Mora¹, A. Maccabruni², L. Pedrotti¹

¹Department of Orthopaedics and Traumatology, University of Pavia, "Città di Pavia" Institute (Pavia-IT); ²Department of Infectious Diseases, IRCCS Policlinico San Matteo, University of Pavia (Pavia-IT)

Differential diagnosis and treatment of a skeletal metabolic abnormality are closely linked to the understanding of the principles of osteogenesis and the knowledge of the essential elements to the bone formation and preservation: bone matrix (osteoid) and adequate concentration of Ca, P and Mg in extracellular fluids.

According to these considerations, the skeletal effects of the metabolic disorders during growth can be classified as (a) changes in osteoid formation, (b) changes in osteoid mineralisation, (c) complex changes affecting osteoid and mineralisation. The most frequent bone metabolic disorders are rickets/osteomalacia and osteoporosis: the orthopedic implications of rickets and some "emerging" features of osteoporosis in children and adolescents need to be discussed.

Vitamin D deficiency is rarely seen today in developed countries; for this reason rickets has generally an endogenous origin and fails to respond to Vitamin D administration.

The most frequent type is the currently called "X-linked" (or "XLH") hypophosphatemic rickets, transmitted as X-linked dominant character, with an incidence of 1/20,000.

Even if the clinical and radiological features are undistinguishable from rickets related to Vitamin D deficiency, this disorder depends on a decreased renal tubular phosphate reabsorption.

In addition to the medical therapy (administration of phosphate), a surgical treatment is often needed, in order to correct complex deformities of the limbs: in these cases a careful planning and the

use of compression-distraction techniques usually allows to obtain a gradual correction of the deformities, with very good results.

The values of bone density are one of the best parameters for the prediction of fracture risk in adults. Since the peak of bone mass depends on genetic and environmental factors, the evaluation of the "state of bone health" in pediatric populations is a matter of the highest importance.

In particular, in HIV-infected children, patterns of lower bone density (where both illness and dismetabolic effects of antiretroviral drugs seem interfere) are reported. Moreover, recent studies demonstrate that the risk for osteopenia/osteoporosis is correlated with immunodeficiency progression.

As more and more cases of osteonecrosis and fractures among patients receiving antiretroviral drugs are being reported, it is important to minimize from childhood and adolescence the risk of skeletal deformities and pathological fractures. In these cases, an early diagnosis with the aid of ultrasonographic densitometry can allow to take more effective prophylactic and therapeutic measures.

PATHOGENESIS OF THE NEONATAL SEPTIC OSTEO-ARTHRITIS (NSOA): AN EXPERIMENTAL STUDY

R. Facchini

Milan-IT

The study of the etiopathogenesis of the Neonatal Septic Osteoarthritis (NSOA), an increasing disease in these last years, has been object of numerous experimental investigation in the past and recent years. Many Authors have reproduced this disease through the oral way, subcutaneous way, intrarticular way and venous way. The clinic observation of many NSOA gave us the opportunity to study the exact pathogenetic mechanism of this disease at the 3rd. Orthopaedic Department of University of Milan. After few experiments using the intra-articular way on rabbits, we began inducing the disease through the catheterization of the umbilical vein. In fact the clinical statistics was noted an high percentage of NSOA in newborn "at risk" when treated with the diagnostic and therapeutic umbilical catheterization. We did not succeed in inducing the NSOA after umbilical catheterization in rabbits and pigs. In fact we technical difficulties in the catheterization due to a precocious closure of the umbilical vessels in the first and we induced hepatic abscesses in the second. The calf demonstrated to be ideal for this experiment because it has not a precocious closing of the umbilical vessels and it has not demonstrated manifestation of hepatic abscess. The calves have some anatomical characteristics identical to humans as the presence of the Aranzio duct and of the metaphyso-epiphyseal circulation, which are indispensable for the diffusion of the infectin process in newborn. During the first week all the animals presented an increase in body with a clear decline in general conditions and articular localization in four calves (elbow, carpo-metacarpale joint, interphalangeal joint, hip, ankle). At 14 days the joints previously indicated showed swelling but with an improvement of the general condition. At 30 days all the animal were in good general condition; only in three persisted a local swelling of the interested joints with pain and limping. At 90 days the interested joint showed a normal aspect but a few animals had a limitation of the articular excursion. At 14 days, with the exception of one calf, we observed the presence of swelling of the soft tissue associated with diffuse porosity of the articular heads. At 30 days three calves showed a major diffusion of osteoporosis of the parts involved with the presence of a few osteolytic lacunas. The cortical bone, at the height of the metaphysic, resulted in more parts damaged with erosion and discontinuity caused by the diffusion of the septic process towards the exterior. The reaction of the periosteuma and the initial disarrangement of the joint space began to show its

severity. At 90 days the small osteolytic lacunas joined together and form necrotic areas; the periosteal reaction extended, and the deep erosions of the articular cartilages led to the ankylosis. We observed radiographic modifications at the elbow (medial humeral condyle), carpo-metacarpal joint, metacarpo-phalangeal joint, hip (femoral head), ankle. At 14 days all the interested joint underwent an aspiration and showed the presence of turbid yellow matter; at the cultural examination resulted the presence of the *Staphylococcus Aureus* used to induce the NSOA. At the slaughter of the animal (90 days), an anatomo-pathological study of the interested joints was done. At this examination the synovia and the capsule presented an hypertrophy; the articular cartilage were damaged with ulceration and the involvement of the bone underneath. Furthermore the articular heads interested with NSOA presented severe morphological alterations. At the histological examination we found the presence of numerous inflammatory cells above all disposed around the synovial vessels in the zones where probably previously were abscesses. At the epiphysis the cartilage was reduced and we observed remodeling of the bone structure. The medullary cavity was not altered. The experimental reproduction of a NSOA induce by the catheterization of the umbilical vein in an animal which has the same metabolic, vascular, immunitary characteristics of a newborn man seems to confirm the pathogenetic hypothesis, proposed in the past, that there is a direct cause-effect connection between the catheterization, the following defilement of the catheter and the development of a NSOA. The Authors expose an experimental study on the pathogenesis of the Neonatal Septic Osteoarthritis (NSOA), induced in rabbits, pigs and calves through the catheterization of the umbilical vein. Examining the clinical, radiological, laboratory and anatomo-pathological findings shows that the catheterization of the umbilical vein seems to be the most frequent pathogenetic cause of the NSOA.

PERTHES DISEASE: MRI PROGNOSTIC CLASSIFICATION AND PATHOMORPHOGENESIS

F. Rondinella¹, N. de Sanctis²

¹Pediatric Orthopaedic Service, Marcianise Hospital, ASL CE/1 (Caserta-IT); ² Department of Orthopaedics, Campolongo Hospital (Salerno-IT)

The most common system of grading Legg-Calvé-Perthes disease (LCPD) is still the radiographic grouping by Catterall, although the lack of interobserver reliability [1]. The predictive value of Herring's "lateral pillar" classification is also accepted. In a previous paper [2], we demonstrated the good reliability and the predictive value of four magnetic resonance imaging (MRI) indices (extension of necrosis, lateral extrusion, physeal involvement, metaphyseal changes) through their correlation to clinical and radiographic conditions of the hips at follow-up. The same good results were obtained by submitting to statistical analysis a second group of 31 patients (French series). On the basis of these statistical studies, a new classification has been proposed. It takes into account the three MRI risk signs: extent of necrosis and two, lateral extrusion and physeal involvement. The extent of necrosis up to or more than 50% separates two main groups, A and B. The association of the last two MRI risk factors distinguished six classes with different prognoses. Appropriated treatment also is suggested for each class. Our MRI study of LCPD also led us to formulate a pathomorphogenetic model we called "packed capsule". According to this biomechanical model, the femoral head has a segment of a sphere-like shape made of viscoelastic material (the epiphyseal cartilage) and is hermetically sealed. The femoral head is deformed by the increasing pressure of the necrotic fluid collected inside the capsule under the weight-bearing forces. Finally, our suggestion in the

treatment of Perthes disease is to relieve weight bearing up to the fragmentation stage. During this stage, MRI is extremely useful in performing prognosis; at this time our classification can be applied, and the corresponding treatment can be followed.

References

1. Herring JA (1994) The treatment of Legg-Calvé-Perthes disease. A critical review of the literature. *J Bone Joint Surg Am* 76(3):448–458
2. de Sanctis N, Rega AN, Rondinella F (2000) Prognostic evaluation of Legg-Calvé-Perthes disease by MRI. Part I: the role of physeal involvement. *J Pediatr Orthop* 20(4):455–462

HISTOPATHOLOGIC CHANGES IN THE GROWTH PLATE CARTILAGE OF PROXIMAL FEMORAL EPIPHYSIS FOLLOWING INTERRUPTION OF BLOOD SUPPLY: AN EXPERIMENTAL INVESTIGATION IN IMMATURE RABBITS

C. Tudisco¹, F. Botti¹, E. Savarese¹, A. Febo², F.R. Rossetti¹, E. Ippolito¹

¹Ospedale Universitario “Tor Vergata” (Rome-IT); ²Ospedale Israelitico (Rome-IT)

Ischemic necrosis of the capital femoral epiphysis is the consequence of many affections in children, like traumatic or iatrogenic injuries and Legg-Calvé-Perthes disease. A consequence of the ischemic process is a disturbance of the ossification process of the proximal femoral epiphysis with impairment of growth of the secondary center of ossification. Ischemic necrosis of proximal femoral epiphysis was induced in a number of New Zealand rabbits by placing a non absorbable suture ligature around the femoral neck leaving intact the capsula and the ligamentum teres. The rabbits were divided into 2 groups depending on when the ischemic insult was provoked, before and after the appearance of the proximal epiphyseal ossification center. Radiographic and histologic assessments were performed. Ischemic process induced before the appearance of the epiphyseal secondary ossification center showed wide areas of necrosis, cartilage canals with absence of vascular invasion and absence of formation of the secondary ossification center. After 3 weeks, many new accessory centers of ossification were present in the peripheral epiphyseal cartilage with restored endochondral ossification. In the second group of rabbits, in which the ischemic process was induced after the appearance of the secondary center of ossification, the changes after the ischemic insult were less severe than those observed in the previous group of rabbits. Ischemic insult of femoral capital epiphysis resulted in a wide necrosis of the epiphyseal growth plate that was more severe if the ischemia was done before the appearance of the secondary ossification center. The objective of our study was to describe the histopathologic changes that follow an ischemic insult to the proximal femoral epiphysis of immature rabbits.

SURGICAL TECHNIQUE OF SCFE

V. Guzzanti¹, F. Falciglia², M. Giordano²

¹University of Cassino (Cassino-IT); ²Institute of Scientific Research, Children’s Hospital “Bambino Gesù” (Rome-IT)

Objective A single-screw fixation is considered the treatment of choice in slipped capital femoral epiphysis. However this approach improves the growth disturbances of proximal femur in younger patients promoting premature closure of physis [1, 2]. The aim of the study is to evaluate if a modified single-screw and a particular technical fixation could prevent premature closure of the growth plate and avoid re-slip [3].

Material and Methods Eleven young patients (mean bone-age 11.81 years) with monolateral slipped-capital-femoral-epiphysis and significant prediction of neck growth remaining (≥ 1.5 cm) have been considered. The patients were treated anchoring a short-treated part of a modified cannulated screw (three helicoids) in the epiphysis; the smooth screw-shank was left within the physis, and the head of the screw was stopped at distance from the lateral cortex. The minimum follow-up was 36 months. Growth of the epiphyseal-physeal complex was assessed by various measurements. The time of survival of the involved and uninvolved proximal femoral physis was recorded. Clinical assessment hip status was made.

Results No progression of slip or re-slip was measured. No evidence of avascular necrosis or chondrolisis was showed. The mean time of survival of the proximal femoral physis of the involved side (35.27 months) was similar to the uninvolved side (37.18 months). The survival of involved physis was always accompanied by significant growth. All eleven patients showed a partial or total re-covering of exposed metaphysis having an excellent clinical result.

Conclusions The modified single-screw and the particular technical fixation have demonstrated to prevent early physeal closure and avoid re-slip maintaining the known advantages of single-screw fixation when applied in SCFE. That avoided the disturbance of proximal femur in younger patients and its consequences [4] moreover favoring the so-called recovering of exposed metaphysis.

References

1. Loder RT, Aronsson DD, Weinstein SL, Breur GJ, Ganz R, Leunig M (2008) Slipped Capital Femoral Epiphysis. *Instr Course Lect* 57:473–498
2. Maus U, Ihme N, Niedhart C, Abeler E, Kochs A, Gravius S, Ohnsorge JA, Andereya S (2008) Comparison of the treatment of slipped capital femoral epiphysis with K-wires and cannulated titanium screws. *Z Orthop Unfall* 146(2):251–255
3. Guzzanti V, Falciglia F, Stanitski CL (2004) Slipped capital Femoral epiphysis in skeletally immature patients. *J Bone Joint Surg Br* 86(5):731–736
4. Fraitzl CR, Kafer W, Nelitz M, Reichel H (2007) Radiological evidence of femoroacetabular impingement in mild slipped capital femoral epiphysis: a mean follow-up of 14.4 years after pinning in situ. *J Bone Joint Surg Br* 89(12):1592–1596

WRIST AND HAND

A NEW CONCEPT IN PERIPHERAL NERVE REGENERATION BY ARTIFICIAL NERVE-GUIDES

A. Merolli, F. Catalano

Orthopaedics and Hand Surgery, The Catholic University (Rome-IT)

Objective To test *in vivo* an artificial device (“NeuroBox”, patent WO/2008/029373) which, due to its structure, is able to provide mechanical protection and guidance for axonal regeneration and does not require the use of any stitch to be sutured to the nerve stump. The device enables the safe intraoperative use of cyanoacrylic glue instead. It is widely accepted that putting the two nerve stumps under tensional stress will favour fibroblastic and myofibroblastic proliferation and will impair axonal regeneration. But even without tensioning the stumps, it is the use of stitches for the suture (both degradable and not degradable) that promotes fibroblastic and myofibroblastic proliferation, bringing the same complications as above.

Material and Methods The key element of the NeuroBox is the flat Regeneration Chamber: in this compartment the bunch of fibers of the proximal stump is invited to spread on a wider flat

surface. A rigid poly-methylmetacrylate guide as the first prototype. Commercially available buthyl-cyanacrilate was the glue of choice. The dedicated glue-compartment of the NeuroBox promotes the polymerization of the glue. Male Wistar rats weighing about 300 g were used as animal model. The sciatic nerve was cut proximally to its bifurcation and a gap of 4 mm in length ensued. Fixation, Embedding, and Staining were followed by analysis both in visible light microscopy and transmission electron microscopy

Results The normal structure of the nerve is preserved and seems not to be affected by the presence of the acrylic glue all around the fibroelastic sheath. In the Regenerate zone large and small myelinated fibers can be seen in number matching the healthy proximal stump and intraneural vascularisation was observed. There were no signs of intraneural fibrosis or other adverse intraneural reactions but it was notable that there was the complete absence of any fibroelastic outer sheath.

Conclusions The use of stitches may be avoided since the stumps will be held in place by a glue cast around the nerve. It may be speculated, on the basis of these early findings, that the flat regeneration chamber can promote vascularisation of the regenerated tissue avoiding the central tubular necrosis sometimes observed with tubular guides of large diameter.

ANALYSIS OF 16 CORRECTIVE OSTEOTOMIES FOR MALUNION OF THE DISTAL RADIUS

M. Zanlungo, E. Finardi, F. Nasi

3A U.O. Ortopedia, Centro di Chirurgia dell'Arto Superiore, Istituto di Cura Città di Pavia (Pavia-IT), e-mail: mariozanlungo@libero.it, mario.zanlungo@grupposandonato.it

Objective For the symptomatic distal radial malunion we reviewed sixteen patients after corrective opening wedge osteotomy (from 1996 to 2007) to evaluate radiologic and clinical results connected to the surgical technique.

Material and Methods Sixteen patients were treated by opening wedge surgery (12 F and 4M, mean age 47 years, range 21–85 years, 10 left, 6 right) after evaluation of functional demand, articular limitation, pain localization, deformation and radiological change, with osteotomy parallel to articular surface [1–3] and fixation.

Results All osteotomies are consolidate. The extension in Goydrand-Smith fractures improve 51° on average with radiographically correction from 32° to 7°, flexion in Pouteau-Colles fractures improve 40° with radiographically correction from -35° to +2°, grip power restores the pronosupination 60° on average and correction of radius loss. Major complications: loss of the dorsal tilt correction in two cases and uncorrected medial transposition of radius axis in two cases. The clinical results are valued with Green-O'Brien scale modified by Cooney et al. on pain, function, ROM, grip power; we had 5 excellent, 4 good, 6 satisfactory, 1 non satisfactory outcomes.

Discussion and Conclusions We prefer osteotomy of the ulna for the ulna impact with good morphology of the radial epiphysis [2]. The use of volar plate goes to simplify the Goydrand-Smith deformity and restore the correction of the associated hyperpronation. The external fixation was not tolerated. The stability angular plate has a good resistance to support the change of the correction and permit to restore the deformity and, in case of important loss, the medial transposition of radial axis as well. We conclude that reconstructive procedures in patients with distal radius malunion may not completely restore normal function, and every effort should therefore be made to prevent malunion in treatment of distal radius fractures [3].

References

1. Fernandez Diego L (1995) Corrective osteotomy for extra-articular malunion of the distal radius. *Fractures of the distal radius*. Ed. Martin Dunitz 104–117
2. Van Cauwelsert de Wyeis J, de Smet L (2003) Corrective osteotomy for malunion of the distal radius in young and middle age patients: an outcome study. *Chir de la Main* 22(2):84–89
3. Flinkkila T, Raatikainen T, Kaarela O, Hamalainen (2000) Corrective osteotomy for malunion of the radial radius. *Arch Orthop Trauma Surg* 120(1–2):23–26

DISTRACTION ARTHROPLASTY OF THE TRAPEZIO-METACARPAL JOINT: A NEW SURGICAL TECHNIQUE FOR THE TREATMENT OF RIZOARTHRISIS

D. Perugia, M. Guzzini, C. Bufalini

Unit of Orthopaedics, S. Andrea Hospital, University of Rome "La Sapienza" (Rome-IT); Day Surgery Center Maurizio Bufalini of Florence (Florence-IT)

Trapeziometacarpal distraction arthroplasty is a new surgical technique for the treatment of trapeziometacarpal arthrosis. It consists of distracting the first metacarpal and then anchoring it in suspension to the second metacarpal by means of a tendon graft. Both a reduction of the subluxation of the base of the first metacarpal and an opening or distraction of the trapeziometacarpal joint, with a clear decrease in the forces of attrition on its joint surfaces, are thereby obtained.

We evaluated 30 patients (6 men, 24 women) with an average age of 56 years, at 3-year follow-up treated with this surgical procedure. The evaluation was performed using VAS score, D.A.S.H. score, Grind test, Kapandji test and radiological views. We also evaluated complications and patients satisfaction. In every patient there was a reduction of VAS score with a reduction of pain and all patients were satisfied. We had one fracture of 2nd metacarpal in the site of the drill hole treated with a plate. Rx showed in all patients a good reduction of subluxation of the trapezio-metacarpal joint. All patients returned to their normal every day activity.

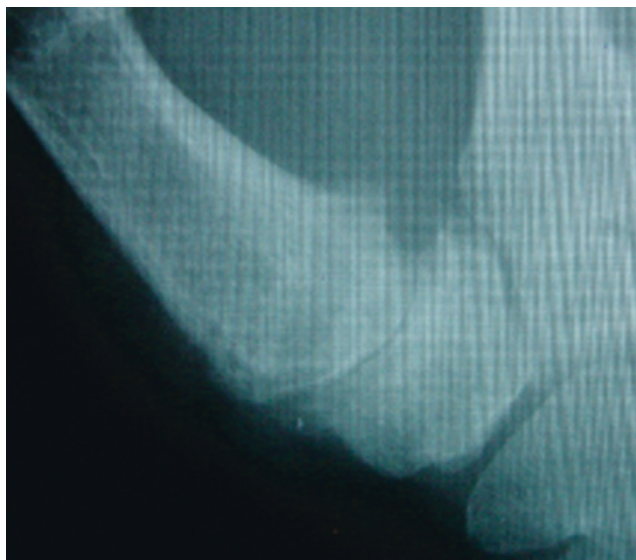


Fig. 1 Pre operative X-ray show a stage 2 of Eaton score with reduction of T-M joint space



Fig. 2 Post operative at 3-year follow-up shows a normal joint space

In conclusion, this technique seems to be a good procedure in patients with stage 1 to 3 of Eaton score. This technique avoids trapeziectomy and it is therefore less destructive but equally effective regarding pain, correcting the deformity and recovering grip strength compared with the traditional techniques of arthroplasty.

HEMITRAPEZIECTOMY AND INTERPOSITION ARTHROPLASTY: A NEW SURGICAL TECHNIQUE

A. Teti, N. Buzzelli, F. Falez

Department of Orthopaedics and Traumatology, S. Spirito Hospital, A.S.L. Roma/E (Rome-IT)

Introduction Tendon suspension sling arthroplasty is a technique often used for surgical treatment of osteoarthritis of the trapezio-metacarpal joint, because of more than 90% of excellent and good results, without complications related to prosthesis implant, at a low cost, with a period of immobilization shorter than arthrodesis. In order to avoid complications related to tendon suspension arthroplasty, the Authors propose a simple surgical technique of hemitrapeziectomy and interposition arthroplasty for osteoarthritis of the trapezio-metacarpal joint.

Material and Methods Ten patients (seven women and three men), age range 47–73 years, suffering from osteoarthritis of the trapezio-metacarpal joint without radiographic signs of osteoarthritis in any other close joint, were surgically treated removing the half distal part of the trapezium and implanting a cylinder of sponge of hemostatic gelatin. A brace was permanently applied for fifteen days after surgery; for the following fifteen days the patient was allowed removing progressively the brace and to perform active movements of the thumb; thirty days after surgery the brace was removed and the patient was authorized to perform all of active and passive movements. Three patients needed post-operative physiotherapy.

Results Clinical and radiographic evaluation was performed one year after surgery. Nine patients were satisfied with surgery. Six patients had a complete recovery of the ROM of the thumb; they were able to perform all of the activities as prior to surgery, without local symptoms. In two patients a slight reduction of the ROM of the trapezio-metacarpal joint was observed, without local symptoms or limitation of any activity. In a patient a significant reduction of the ROM of the trapezio-metacarpal joint and of the first carpo-metacarpal joint was observed. In a patient a post-operative dislocation of the cylinder of sponge of hemostatic gelatin was observed.

Conclusions Preliminary results suggest that this surgical technique is extremely simple, quick and effective. The Authors recommend at the moment this surgical technique only for idiopathic osteoarthritis of the trapezio-metacarpal joint without radiographic signs of osteoarthritis in any close joint, when the patient needs a quick resumption of light manual work. Large case studies and long follow-up are needed in order to evaluate the effectiveness of the technique.

ORAL COMMUNICATIONS

KNEE I

COMPUTER ASSISTED SURGERY IN MOBILE BEARING TOTAL KNEE ARTHROPLASTY

F. Conteduca, F. Massai, R. Iorio, A. Ferretti

Orthopaedic Unit, Sant'Andrea Hospital (Rome-IT)

Introduction Accurate reconstruction of inferior limb alignment should offer the best chance to achieve good mid to long term results in TKA. The aim of this study is to compare the radiological outcome and intra and postoperative blood loss in conventional and computer assisted techniques in mobile bearing TKA.

Methods One hundred consecutive TKA with LCS (Depuy Int, Warsaw) were included in this study. The patients were randomly assigned to enter the study group (CAOS technique) or the control group (Standard technique). Post operative mechanical and anatomical axes were assessed by full-length weight bearing radiographs. The total blood loss was determined according to the method of Rosencher et al. Statistical analysis was performed using unpaired t-test, Wilcoxon test and X2 test. SAS software was used for computations.

Results The mean post operative coronal mechanical femoro tibial angle was 3.4° in the control group and 1.7° in the study group ($p = 0.002$). The average total blood loss was 1974 ml in the control group and 1677 ml in the study group ($p = 0.028$).

Discussion and Conclusions Our data suggest that CAOS may improve surgical accuracy in component positioning and reduce the total blood loss in mobile bearing TKA. Long term follow-up are required to confirm that this improvement actually results in a better clinical outcomes and in a longer longevity of the implant.

NAVIGATION IN THE KNEE PROSTHETIC SURGERY: A THREE-YEAR EXPERIENCE USING VISION BRAINLAB VECTOR SYSTEM

F.P. Ciampa, D. Palmieri, P. Giuliani, A. Ntarelli, L. Guerra

Unit of Orthopedics and Traumatology, "St. Spirit" Civil Hospital (Pescara-IT)

Objective In the knee prosthetic surgery, as demonstrated by many authors, the accurate positioning of the prothetic components seems to be the essential element for a good and long survival of the prosthesis. A computer-assisted prothetic surgery could ensure greater reliability in terms of alignment and ligament balancing. We present our experience in three years with Brainlab Vector Visio and Depuy LCS implant.

Material and Methods From March 2005 to September 2007 were compared two groups of patients: 30 treated with conventional knee arthroprosthesis and 30 with navigated knee arthroprosthesis. All prostheses were of the same type and were implanted by the same operator. A radiographic assessment was made to all patients with a pre- and post-surgery X-ray control in the antero-posterior, lateral and axial- patella projection to have the main radiographic angles (AM, AF, AT, LF, LT). The loss of post-operative blood and the value of hemoglobin were also considered. Finally, all patients were assessed through the clinical IKDC scale.

Results In patients with navigated knee arthroprosthesis we observed a more accurate positioning of the prosthesis component (greater uniformity of angular results in terms of mechanical axis) and more accurately ligament balancing (as for the conventional prosthesis), which is fundamental in our type of prosthesis (high

congruence). Also we noticed less blood loss because the intramedullary femoral nail was not used.

Discussion and Conclusions The navigation is a reliable system that requires a learning curve with an initial lengthening of 25–30 minutes in operating time that, with experience, becomes 15 minutes. The navigation is a valuable instrument in the construction of a prosthesis (both for expert surgeons and for those who are making the first steps in the prosthetic surgery). Further improvements are desirable regarding software and hardware, in particular for the control of the ligament balancing and for the assessment of the extensor compartment. We found a more rapid clinical recovery after 6 months in navigated prostheses. We cannot say anything about durability for the brevity of the follow-up.

PRELIMINARY RESULTS OF 90 TOTAL KNEE PROSTHESES IMPLANTED BETWEEN DECEMBER 2007 AND FEBRUARY 2008 WITH THE AID OF "THE TRANSEPICONDILAR ALIGNER"

G. Pipino¹, D.C. Vaccarisi²

¹Villa Regina Private Hospital (Bologna-IT); ²Vignola Civil Hospital (Modena-IT)

Introduction Instrumentation of all total knee prosthesis actually on commerce allows orienting femoral cutting block between 0° and 3° of external rotation; this alignment is chosen empirically or it is based on surgeon experience and thus sometimes may be wrong. We tried to plan a new device to sort this problem out: The Transepicondilar Aligner. It allows marking exactly trans-epicondilar line, driving orientation of femoral cutting block and guaranteeing a better femoral component positioning.

Material and Methods We have analysed data of first 90 TKA implanted between December 2007 to February 2008 (75 female e 15 male, 60 right knees e 30 left knees); mean age was 68 years. We have used total knee prosthesis of different companies, minimally-invasive technique and miniparapatellar approach. Parameters considered for results evaluation are: X-ray evaluation of femoral component rotation, anterior knee pain, lateral release and medial plastic number, Q angle, knee prosthesis stability, range of motion in flexion, patient satisfaction.

Results The transepicondilar aligner reduced anterior knee pain and maltracking cases, no lateral release and medial plastic was necessary to obtain right alignment and good patellar tracking. Q-angle was always respected, no ligament balancing was necessary, knee prosthesis stability improved such as knee flexion range.

ACCURACY OF THE EXTRAMEDULLARY TIBIAL CUTTING GUIDE IN TOTAL KNEE ARTHROPLASTY

G. Cinotti, N. Lucioi, E. Ferrari

I Orthopaedic Clinic, University of Rome "La Sapienza" (Rome-IT)

Introduction Several studies have shown that, using navigation, the accuracy of bone cuts and the final alignment of total knee arthroplasty (TKA) is more accurate than with the standard procedure. However, it is not clear whether such advantages, compared to non-navigated TKA, are inherent to the positioning of only one or both the femoral and tibial component. Aim of the study was to analyze the accuracy of the extramedullary tibial cutting guide compared to the navigated tibial bone cut.

Material and Methods A connector was designed to tightly link the extramedullary tibial guide currently used during standard TKA, to a navigated tibial cutting guide (Orthopilot System). During surgery,

the manual extramedullary tibial guide was positioned by the operating surgeon in order to obtain 0° tibial coronal and sagittal cuts. Once the surgeon was satisfied of the positioning the tibial cutting guide, cables for navigation were applied on the cutting guide and the spatial orientation of the guide was recorded on the computer. The procedure was repeated in 35 consecutive patients submitted to TKA.

Results The cutting guide was found to be in a varus-valgus alignment <2° in 23 patients, <3° in 8 and <4° in 4. In the sagittal plane, the posterior slope (anterior or posterior) was <2° in 10 patients, <3° in 12, <4° in 11, <5° in 1 and <6° in 1.

Conclusions The extramedullary tibial guide allows the surgeon to obtain a satisfactory positioning (<2°) of the cutting guide in the coronal plane in the majority of cases. However, in the sagittal plane, using the manual extramedullary guide, a satisfactory positioning of the cutting guide was obtained only in 20% of cases.

CORONAL ALIGNMENT AFTER NAVIGATED TOTAL KNEE ARTHROPLASTY DURING THE WHOLE RANGE OF MOTION

G. Cinotti, E. Ferrari, N. Luciola

I Orthopaedic Clinic, University of Rome "La Sapienza" (Rome-IT)

Introduction Surgical navigation in total knee arthroplasty (TKA) was found to improve the coronal alignment of the operated limb compared to the standard procedure. Moreover, the navigation allows the surgeon to record the coronal alignment before and after the operation, from full extension to full flexion. Despite several studies analyzed the coronal alignment of the knee in full extension after TKA, little is known on the changes in the coronal alignment of the knee during the whole range of motion before and after surgery.

Material and Methods We analyzed 40 patients (24 women and 16 men, mean age 73 years) who underwent navigated TKA. In all patients a medial parapatellar approach was used. The rotation of the femoral component was determined using both the posterior condylar axis and the Whiteside line. The coronal alignment of the operated limb was evaluated before the operation at 0, 30°, 60°, 90° and 120° and then repeated after TKA.

Results Before surgery, the femur-tibial mechanical axis was on average 2° in varus (range 0–12°). The maximum deformity was observed at 60° and 90° of flexion. The average difference between the coronal deformity recorded in full extension and at 60–90° of flexion was 6° (range 3°–11°). After surgery, the difference between the coronal alignment in full extension and at 60–90° of flexion, was on average 2° ($p < 0.05$ compared to the measurement performed before surgery).

Conclusions Navigation allows the surgeon an accurate monitoring of the coronal alignment of the knee in the whole range of motion. Our results showed that the maximum deformity is reached at 60–90° of flexion. After navigated TKA there is a correction of the coronal deformity of the knee in the whole range of motion.

ALIGNMENT DEFECTS IN MEDIAL UNICOMPARTMENTAL KNEE ARTHROPLASTY WITH A MINIMALLY INVASIVE SURGICAL APPROACH

V. Sessa, P. Beatrice, F. Forconi

U.O.C. Ortopedia, Ospedale S. Giovanni Calibita (Rome-IT); Fatebenefratelli (Rome-IT); A.F.A.R (Rome-IT)

Introduction Long-term clinical results in a unicompartmental knee arthroplasty (UKA) can be compromised by many different

complications. In the recent past, the most frequent causes of implant failure were polyethylene wearing and aseptic loosening. Today, with progress in prosthetic design and materials, poor implant results are most commonly caused by arthritic progression of the lateral and patellar-femoral compartments. It is essential a careful selection of patients and a proper implant alignment. The main goal of our study was to define the incidence and effective clinical relevance of alignment defects in the medial UKA with a minimally invasive surgical approach.

Material and Methods The study included forty patients operated on consecutively from 2004 to 2006 by the same senior surgeon. A minimally invasive medial UKA implant was performed and the same prosthesis was implanted in each case. Alignment was recorded by measuring the following parameters: tibiofemoral angle, femoral joint line orientation, tibial joint line orientation, prosthesis-tibial angle, and posterior tibial slope. Long-term clinical evaluation was effected on the basis of the Knee Society Scoring System recorded at 12 and 24 month follow-up. Clinical and radiographical (X-ray) outcomes were compared in order to evaluate their effective correspondence and to quantify tolerance limits.

Results All patients had at least one altered radiographical parameter; nonetheless, only three of them (7.5%) had less satisfactory clinical results, too. Tibiofemoral angle of the symptomatic cases was always in the correct range. Femoral joint line orientation and tibial-joint line orientation were each out of range limits in two cases and prosthesis-tibial angle and posterior tibial slope in three cases each. In the symptomatic patients, the femoral joint line orientation was out of limits by no more than 3.2°; tibial joint line orientation by no more than 1.5°, prosthesis-tibial angle by no more than 3.5° and posterior tibial slope by no more than 5.8°. As this data shows, in our study, prosthesis-tibial angle and posterior tibial slope were the most common misalignments associated with some clinical finding. Furthermore, tibial joint orientation was the most sensitive alignment parameter for symptomatic correspondence.

Conclusions Although no patient had all radiographic parameters within the range of perfect alignment, very few of them (7.5%) had less satisfactory clinical outcomes at follow-up. Furthermore, since abnormalities in tibial joint line orientation, prosthesis-tibial angle and posterior tibial slope were more involved than other parameters in implant failure, these should be given particular attention during surgery.

TREATMENT OF MEDIAL UNICOMPARTMENTAL ARTHRITIS OF THE KNEE: HIGH TIBIAL OSTEOTOMY VERSUS UNICOMPARTMENTAL ARTHROPLASTY. 2-4-YEAR FOLLOW-UP PROSPECTIVE STUDY

F. Dettoni¹, G.L. Maistrelli², D. Stojimirovic², D.E. Bonasia¹, M. Bruzzone¹, F. Castoldi¹, R. Rossi¹

¹Ospedale Mauriziano Umberto I (Turin-IT); ²Toronto East General Hospital (Toronto-CA)

Aims Medial unicompartmental knee arthritis can be in most cases treated either with a Unicompartmental Knee Arthroplasty [UKA] or a High Tibial Osteotomy [HTO]. Aim of this prospective study was to compare clinical and functional results at short term follow-up of 54 consecutive Opening Wedge HTO, versus 56 UKA, implanted between 2001 and 2004 in our two Orthopaedic Divisions.

Material and Methods Accuris UKA (Smith&Nephew) was implanted in 56 patients (28 M, 28 F); 54 patients (29 M, 25 F) were treated by a medial opening wedge osteotomy with a Puddu plate (Arthrex). The two groups were comparable regarding gender, weight (BMI) and preoperative assessment, while there was a significant difference in mean age: HTO 55 years vs. UKA 65 years. All patients were evaluated preoperatively and at 6 months, 1, 2 and 3 years, using two ques-

tionnaires: the Knee Society Score (KSS) and WOMAC O.I. Student-*t* test was performed (using the SPSS 13.0 statistical software).

Results Postoperative protocol for UKA was: 1 month knee brace, CPM from day one and full weightbearing from day 2. This led to a mean rehabilitation time of 4.3 weeks. Postoperative protocol for HTO included CPM from day 5 and 30 days partial weightbearing, so that rehabilitation time was longer in this group (mean: 7.2 weeks). KSS and WOMAC scores are reported below:

Knee Society Score - UKA

	Preop	6 months	1 year	3 years
KS	43	85	92	93
FS	50	73	82	84
TOT	93	158	174	177

Knee Society Score - HTO

	Preop	6 months	1 year	3 years
KS	38	71	78	76
FS	55	76	91	91
TOT	93	147	169	167

WOMAC

	Preop	6 months	1 year	3 years
UKA	45	15	12	14
HTO	48	21	11	15

Discussion and Conclusions Both KSS and Womac showed a satisfactory improvement already from the first postoperative evaluation, reaching a good to excellent level at 1 year, in both treatment groups. Differences between the two groups are not statistically significant; nevertheless UKA show a slightly better knee score, while HTO obtain a better function score. In conclusion, according to our data, we can affirm that both treatment lead to satisfactory outcomes at 3 year follow-up. No difference between the two groups was seen regarding patient's satisfaction. UKA obtain better knee scores, i.e. better pain relief and range of motion; while HTO obtain better function score, i.e. better walking and climbing stairs ability. UKA have a faster recovery, with a shorter rehabilitation time. Regarding survivorship analysis, a longer follow-up is required.

UNICOMPARTMENTAL KNEE REPLACEMENT: INDICATIONS TECHNIQUE AND RESULTS

A. Schiavone Panni, M. Vasso, M. Tartarone, S. Cerciello, C. Mazzotta, D. Santaiti

Department of Science for Health, University of Molise (Campobasso-IT)

Recent increased interest in less invasive surgical techniques has led to a concurrent resurgence in unicompartmental knee arthroplasty (UKA). This procedure has evolved significantly over the past three decades.

Recognized advantages of unicompartmental replacement include lower perioperative morbidity with minor blood loss and post-operative pain, and consequent earlier recovery.

Careful selection of patients is required: unicompartmental medial or lateral osteoarthritis or avascular osteonecrosis, less than 10

degrees of flexion contracture, correctable varus not exceeding 15 degrees, and an intact anterior cruciate ligament. Anterior knee pain and/or radiological evidence of degeneration of the patellofemoral joint are considered to be contraindications to UKA. Recent reports have demonstrated success in expanding the classic indications to younger patients, but also to patients aged 70 years and above, in whom this procedure may represent the definitive solution.

We prospectively evaluated 50 consecutive UKAs for medial or lateral compartment osteoarthritis or osteonecrosis, with a 5-year maximum follow-up. In all patients we performed a unicompartmental knee replacement with the ZUK (Zimmer, Warsaw, IN, USA) prosthesis, characterized by a metal-backed design.

Evaluation included Knee Society clinical scores and functional scores, and radiographic evaluation of limb alignment and component placement.

There were no perioperative complications. There was not any case of osteoarthritis progression at the last follow-up, and septic or aseptic complications did not occur in any patients, so that no unicompartmental implant had to be revised. However, conversion of a failed unicompartmental knee arthroplasty to a total knee arthroplasty (TKA) may be technically demanding, but may be done successfully with careful preoperative planning and possible need for revision techniques, such as stem extension and metal augmentation. Moreover, it has been showed that the results are comparable to the results of primary TKAs.

Polyethylene wear and consequent osteolysis and aseptic loosening have been described as the predominant failure mechanism in more contemporary unicompartmental designs. Proper execution of surgical technique and strictly selective indications remain critical to optimizing outcome.

Survival of UKA prostheses has been reported approximately 85–95%, compared with at least 90% for TKA at 10 years follow-up. Survivorship for high tibial osteotomy (HTO) appears to be less than 85%. It is not clear whether there are more revisions after UKA than TKA, but there appear to be fewer revisions in UKA compared with HTO. Certainly, unicompartmental knee replacement is associated with a lower risk of infection compared with total knee replacement.

ACL SPARING IN KNEE REPLACEMENT: BI-UNICOMPARTMENTAL VERSUS TOTAL KNEE ARTHROPLASTY. A MATCHED PAIRED STUDY

A. Manzotti¹, F. Montironi¹, P. Cerveri², E. De Momi², N. Confalonieri¹

¹1st Orthopaedic Department, CTO Hospital, ICP (Milan-IT); ²Bio-engineering Department, Politecnico di Milano (Milan-IT)

Introduction The Authors performed a matched paired study between 2 groups: bi-Unicompartmental (Bi-UKR) versus Total Knee Replacements (TKR) for the treatment of isolated bicompartamental tibio-femoral knee arthritis with an asymptomatic patellofemoral joint. The Authors believe that Bi-UKR could achieve comparable outcomes to TKR, but with a real less invasive surgery and maintaining a higher joint function.

Material and Methods Twenty-two patients with bicompartamental tibio-femoral knee arthritis, who underwent to BI-UKR between January 1999 and March 2003, were included in the study (group A). In all the knees the arthritic changes were graded according to the classification of Ålback. All patients had an asymptomatic patellofemoral joint. All patients had a varus deformity lower than 8°, a body-mass index lower than 34, no clinical evidence of ACL laxity or flexion deformity and a preoperative range of motion of a least

110°. At a minimum follow-up of 48 months, every single patient in group A was matched with a patient who had undergone a computer assisted TKR between August 1999 and September 2002 (group B). In the bi-UKR group, in 2 cases we registered intraoperatively the avulsion of the treated tibial spines, requiring intra-operative internal fixation and without adverse effects on the final outcome. Statistical analysis of the results was performed.

Results At a minimum follow-up of 48 months there were no statistical significant differences in the surgical time while the hospital stay was statistically longer in TKR group. No statistically significant difference was seen for the Knee Society, Functional and GIUM scores between the 2 groups. Statistically significant better WOMAC Function and Stiffness indexes were registered for the Bi-UKR group. TKR implants were statistically better aligned with all the implants positioned within 4 degrees of an ideal hip-knee-ankle (HKA) angle of 180°.

Conclusions The results of this 48 months follow-up study suggest that Bi-UKR is a viable option for bicompartamental tibio-femoral arthritis at least as well as TKR but maintaining a higher level of function.

A NEW PROPOSAL OF SURGICAL TREATMENT FOR FEMORO-TIBIAL AND PATELLO-FEMORAL ARTHROSIS

A. Scarchilli, G. Franceschini

VI Divisione, Istituto Chirurgico Ortopedico Traumatologico (Latina-IT)

Introduction Patello-femoral arthritis (III–IV chondral lesions) is now recognized to be relatively common, especially in middle aged women. When arthritis is found in both patello-femoral and femoro-tibial compartments, the unicompartmental knee arthroplasty is generally contra-indicated. Surgical options for patello-femoral arthritis are: patellectomy, debridement, and cartilage transplant, although they do not provide long-term sustainable benefits. The main problems with patello-femoral arthroplasty are patella instability and patella edge loading on the condylar cartilage in flexion. In middle aged patients (50–63 years), the solution should be “the tissue sparing”, because the total prosthesis is too invasive. Since 2003 at the I.C.O.T. (Istituto Chirurgico Ortopedico Traumatologico, Latina) we have used for this pathology an elevation of tibial tubercle (Maquet procedure) associated with the unicompartmental knee arthroplasties.

Material and Methods 11 women treated with unicompartmental knee arthroplasties (Biomet Oxford III) and with the elevation of tibial tubercle. Age: >50 – <65 year-old. No obesity, no prior patello-femoral surgical procedure, no malalignment greater than 7°, stable ligament, other compartment in good shape.

Outcome measurements: *Pre-op*: Clinical analysis according to the HSS (Hospital for Special Surgery Knee Score), radiological evaluation according to the “Knee Society, Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System” CT scan, arthroscopy evaluation. *Post-op*: Clinical examination at day 10, week 6 and month 3, 6, 12, 18, 24, 36. X-ray at day 20 and month 3, 6, 12, 24, 36.

The mean preoperative knee score was 55 points (range, 30–79 points), it significantly improved to 90 points at the final follow-up. All patient presented patello-femoral symptoms in the preoperative face that decreased markedly within two years. Only 1 patient (9%) at the final stage had moderate or severe patello-femoral symptoms. No component was radiographically loose and no osteolysis was seen. We didn't note any change in patello-femoral X-ray examination.

Results This procedure uni + Maquet has limited indications: Grade III-IV of arthrosis in middle-aged without severe mal-

tracking, inflammatory arthritis, crystalline arthropathy or high demands. In our experience we refer to a few number of cases and a short observation time. With a more binding rehabilitation and correct indications we noted that the pain score significantly improved after the operation and remained unchanged to date observation. The success rate was good-excellent in 86 % of cases in the short and middle term.

Conclusions The elevation tibial tubercle + uni allows to extend the indications for unicompartmental knee arthroplasty in middle-aged with femoro-tibial and patello-femoral arthrosis and it is a valide alternative to the total knee replacement or uni + patello-femoral arthroplasty.

Suggested readings

- Berger RA, Meneghini RM, Sheinkop MB, Della Valle CJ, Jacobs (2005) The progression of patellofemoral arthrosis after medial unicompartmental replacement: results at 11 to 15 years. *J Bone Joint Surg Am* 87(5):999–1006
- Fulkerson JP et al (2005) Alternatives to patellofemoral arthroplasty. *Clin Orthop Relat Res* 436:76–80
- Lotke PA, Lonner JH (2005) Patellofemoral arthroplasty: the third compartment. *J Arthroplasty* 20(4 Suppl 2):4–6
- Scarchilli A (1997) La decompressione rotulea: intervento di Maquet. *Atti 1° congresso di Ortopedia Paesi del Mediterraneo. 28° Congresso Nazionale OTODI Ostuni (BR)*
- Scarchilli A.(2007) Protesi monocompartimentale a menisco mobile 5 anni di esperienza. *Libro degli Atti, IV Ed. Orthonews* 36–37
- Schmid F (1993) The Maquet procedure in the treatment of patellofemoral osteoarthritis. Long-term results. *Clin Orthop Relat Res* 294:254–258

HIP 1

HISTORY OF ITALIAN MODULARITY IN THE HIP JOINT PROSTHETIC SURGERY

A. Croce, M. Ometti, P. Dworschak

I Divisione, Clinica Ortopedico-Traumatologica, I Scuola di Specializzazione in Ortopedia e Traumatologia, Centro Studi e Ricerche in Traumatologia dello Sport, Istituto Ortopedico G. Pini, Università degli Studi di Milano (Milan-IT)

The orientation of the neck has consequences on the forces distribution and on the mechanical solicitations transferred to the implant. To this extra-medullar component are related: (1) the connection with the cotyloid cavity component (rotational centre), the cup must be perfectly entered in the Acetabulum in order to provide a perfect hold of the prosthetic head; (2) the positioning on the front plan (varus/valgus-medium/lateral), the prosthetic stem has to fit perfectly the femoral channel in order to allow a perfect hold independently on the extra-medullar and cotyloid cavity component, (3) the positioning on transversal plan (front/retroversion), correction of anatomical not programmable situations like, for example, a strong femur and/or cotyloid cavity front/retroversion, or situation in change during the operation.

This premise shows how important it is, in the hip joint implant surgery, to orient correctly the implant cup in the three-dimensional space, allowing a secure connection between components without compromising fixation, stability or correct joint physiology.

To combine adequately all these aspects it's necessary to have a totally modular system. This philosophy, mathematically proved

by Johnston (1969), clinically proved by authors like Ranawat (1980), Callaghan (1985) and subsequently by Yoder (1988), translates into reality these assumptions creating a “mechanical connection” between stem and cup.

Therefore in 1985 appears the first GPS prosthetic, the first prototype series of modular necks, which finds in this promising theoretical introduction a brilliant technical - scientific confirmation through many studies. Also to the clinical point of view, there is no doubt that modular neck give unquestioned advantages, not only for primary implant but also for revision surgery where correction aspects like lengthening and/or modifications of rotational centre and off-set appear to be more critical. Over the years modular prosthesis have evolved (Anca-fit, Profemur, Recta) consequently also necks have undergone changes both in the form as well as the possible number of corrections.

Today the complete series of modular neck is made by a total of 27 pieces; having the choice of 3 different lengths, the real availability is of 81 points in the three dimensions for the right leg and so for the left one.

Concluding, it's possible to say that the use of modular necks allows adapting a standard implant to different anatomical-physiological features of a patient, without compromising the correct positioning, and so a better chance of a neck and cup stability over time, without increasing to much the number of sizes.

Suggested readings

1. Viceconti M et al (1996) Design-related fretting wear in modular neck prosthesis. *J Biom Mat Res* 30:181–186
2. Croce A, Curti F, Brioschi D, Perego R (2005) Clinical and functional outcome of fixed vs modular neck stem in THR: mid-term follow up on 140 total hip arthroplasties. 18th Annual Symposium of International Society for Technology in Arthroplasty, Kyoto, Japan
3. Croce A, Ometti M (2007) Modular neck prosthesis. International Society for Technology in Arthroplasty, Paris

FEMORAL NECK PRESERVATION AND LATERAL DIRECT APPROACH: A TSS (TISSUE SPARING SURGERY) ITALIAN SOLUTION

F. Biggi, C. D'Antimo, S. Di Fabio, T. Pagliara, C. Canu

UOA di Ortopedia e Traumatologia, Ospedale San Martino (Belluno-IT)

Actual hip prosthetic surgery is characterized by surgical and technological solutions oriented on respecting the individual anatomy, articular biomechanics and non-pathological bone tissue. European and Italian culture, proposed different innovative solutions since the beginning of hip replacement surgery: we can consider the resurfacing proposed by Wagner and Mc Minn, the neck preservation as emphasized by Pipino, Freeman and Hugler, arriving to the very new mini-stem as proposed by Santori. We apply the neck preserving technique, utilizing the T.O.P./C.F.P. system, since 9 years, with 300 implants until now in patients between 17 and 75 years, with a diagnosis of primary hip arthritis, rheumatoid arthritis, post-traumatic arthritis and other conditions of inflammatory articular disease. Main advantages of this method are very well known: maximum bone stock preservation both acetabular and femoral side; recovery of biomechanical parameters as off-set, rotation centre, muscle lever arm and limb length; possible utilization of TSS technique, that means small incision, respect of peri-articular soft tissues, and minimal bone resections.

The surgical technique provide a lateral straight incision about 7–8 cm; the fascia lata opening with a detachment sub-periosteal of

medius gluteus and vastus lateralis; the capsulectomy with femoral head dislocation; the head removal by sub-capital transverse osteotomy, and subsequent bone bed preparation in both sides to fit with the uncemented components. Rehabilitation is started immediately post-operatively, with partial weight-bearing at the beginning, and full at 1 month.

We evaluated retrospectively the results of the first 100 cases, with a 6 to 9 years follow-up. The average Harris Hip Score ranged from 46 pre-operatively to 96 post-operatively. Effective bone remodelling was observed around cup and stem, with bone resorption in Gruen zone 1–7 in 35% of cases. DEXA study in 11 patients followed for 7 years, confirmed bone preservation around stem with minimal bone loss.

PROXIMA™: A CONSERVATIVE FEMORAL IMPLANT WITH PRONOUNCED LATERAL FLARE AND METAPHYSEAL FIXATION. A THREE-YEAR MULTICENTRE CLINICAL EXPERIENCE

V. Francione¹, R. Bancalè², S. Ghera³, G. Topa⁴, F.S. Santori³

¹Presidio Ospedaliero G. Mazzini (Teramo-IT); ²Stabilimento Ospedaliero Santa Maria degli Angeli (Putignano, Bari-IT) ³Ospedale S. Pietro Fatebenefratelli (Rome-IT); ⁴Azienda Ospedaliera Bianchi Melacrino Morelli (Reggio Calabria-IT)

Objectives Uncemented total hip arthroplasty (THA) is now generally regarded as the gold standard procedure for younger patients undergoing THA. Due to demographic changes in terms of ageing society and decreased average age of patients undergoing THA, maximizing bone stock preservation becomes crucial for THA. Moreover, the demand for faster functional recovery requires a higher respect for peri-articular soft tissues. DePuy PROXIMA™ femoral implant, and the dedicated “Round the corner” surgical technique, have been specifically developed to address these needs on the ground of previous experience by one of the Authors (FSS) with a proximal loading ultra-short custom made prosthesis, featuring a pronounced lateral flare and absence of a diaphyseal stem [1, 2]. We report our three-year experience with this implant.

Methods We have implanted 578 PROXIMA™ femoral components from March 2005 to March 2008 at our centres. A retrospective review of all cases is ongoing. Aim of the review is the evaluation of clinical results, radiographic findings and patient's quality of life. Clinical assessment is performed according to Harris Hip Score; radiographic evaluation is considering implant alignment as well as any radiological changes in the periprosthetic zones described by Gruen. Finally, patient quality of life is documented using the Oxford questionnaire.

Results All patients reviewed at three-year follow-up ($n = 81$) showed excellent clinical results, with no cases of thigh pain and high level of patient satisfaction. On X-ray the implants look stable over time with positive bone remodeling and endosteal spot welds commonly evident in Gruen zones 2 and 6. No cases of stress shielding have been observed on the reviewed radiographs.

Discussion To date our three-year experience with PROXIMA™ used in THA shows a very satisfactory clinical and radiographic behavior of the implant. Prosthetic geometry, with pronounced lateral flare and absence of a diaphyseal stem, prevents thigh pain.

Conclusions Due to pure metaphyseal loading, the implant seems to determine an optimal periprosthetic bone remodeling, thus allowing bone stock preservation over time.

References

1. Santori FS, Manili M, Fredella N, Tonci Ottieri M, Santori N (2006) Ultra-short stems with proximal load transfer: clinical

and radiographic results at five-year follow-up. *Hip International* 16(S3): S31–S39

2. Santori N, Lucidi M, Santori FS (2006) Proximal load transfer with a stemless uncemented femoral implant. *J Orthopaed Traumatol* 7:154–160

METAL-ON-METAL TOTAL HIP ARTHROPLASTY WITH LARGE HEADS: SHORT TERM FOLLOW-UP

P. Caldora, D. Lup, R. Guarracino, E. Nizami, G. Ciarpaglini

U.O. Ortopedia e Traumatologia, Ospedale S. Margherita Valdichiana, AUSL 8 (Arezzo-IT)

Introduction The authors report the short term results of a new metal-on-metal hip replacement (Durom Hip Sistem – Zimmer, Warsaw, Indiana, USA) using big diameter heads. The study aim was to evaluate: intraoperative and early postoperative complications, prosthetic components placement, early clinical and radiological results and finally the surgeon's learning curve [1–3].

Material and Methods At our Unit, from March 2005 to September 2007, 70 Durom Cup were implanted in 65 patients. In 67 cases we used a CLS stem and in 3 cases a Conus stem. Twenty-nine patients were men and 36 were women, and their mean age was 62 years (range 34–75 years). In all the cases a mini posterolateral approach was performed. Pre and postoperative clinical assessment has been performed using the Harris Hip Scores (HHS). The post-operative radiographic analysis has been performed to evaluate the position of the implants compared to preoperative planning.

Results At a mean follow-up of 20 months (range 6–36 months), clinical and radiographic results are good or satisfactory in all the patients. No dislocations or infections and early aseptic loosening have occurred. Until now no periprosthetic osteolysis or stress-shielding images have been found.

Conclusions In our study, up to now we observed no dislocations and/or components impingement; moreover we evaluated an increase of the R.O.M. comparing with the previous standard prostheses. In our short experience the metal on metal Total Hip Replacement with large heads represents a viable choice, a safe procedure with acceptable surgeon's learning curve even though major series, further informations and long term clinical results are necessary to evaluate the long lasting failure rates.

References

1. Cuckler JM (2005) The rationale for Metal-on-Metal Total Hip Arthroplasty. *C.O.R.R.* 441:132–136
2. Crowninshield RD et al (2004) Biomechanics of large heads: what they do and don't do. *C.O.R.R.* 429:102–107
3. Smith TM et al (2005) Metal on Metal Total Hip Arthroplasty with large heads may prevent early dislocation. *C.O.R.R.* 441:137–142

TREATMENT OF ADVANCED FEMORAL HEAD AVASCULAR NECROSIS WITH BIRMINGHAM MID HEAD RESECTION (B.M.H.R.) ARTHROPLASTY

F. Favetti, F. Casella, M. Papalia, G. Panegrossi, F. Falez

Department of Orthopaedics and Traumatology, Santo Spirito in Sassia Hospital (Rome-IT)

Objective Resurfacing replacement represents the most conservative solution available for total arthroplasty of the hip. Its extreme preservation makes this implant definitely indicated for young and active people, saving most of bone stock for future revisions and conceding a functional joint restoration similar to

physiologic range. However, these implants are not suggested in advanced femoral head avascular necrosis, in which generally the main surgeon's choice is more oriented to conventional total hip arthroplasty. Actually even in these femoral head diseases, preservation of bone stock is still available, by using a cementless resurfacing arthroplasty (BMHR) that provide a mid femoral head resection, with positioning of a press-fit stem (in the head-neck junction) on which femoral head component is applied.

Material and Methods We are performing these implants since January 2007. Young age (included between 30 and 60 years), advanced avascular necrosis of femoral head (Steimberg III and IV) have been considered as indication for this implants. Each of them has been implanted using a postero-lateral approach performed always by the same surgeon. Clinical evaluation has been based upon Harris Hip Score (HHS) pre-operatively and post-operatively, radiographics findings (radiolucency, osteolysis, bone thickening, femoral notching) have been analyzed and registered on the basis of Gruen scheme, while implant orientation of femoral components has been related to neck inclination (varus/valgus).

Results Post-operative HHS [1] for the whole cohort was 77.8 in the first month, 94 in third month. Implant orientation has shown a proper positioning defined as a variation from physiologic axis in AP included between ± 5 degrees, the most of the implants shown a valgus orientation (mean 6.4° , range 6° – 8°). Radiographic evaluation in accordance to Gruen [2] method has shown in all cases the absence of radiolucency.

Discussion The mid head resection resurfacing arthroplasty (BMHR) can be considered an efficient alternative to conventional hip arthroplasty in advanced avascular necrosis of femoral head (Steimberg III or more). It represents the less invasive femoral solution available for primary procedures in these femoral diseases, saving most of bone stock for future revisions and conceding a functional joint restoration that falls within physiological range as for conventional resurfacing.

References

1. Harris H (1969) Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg* 51A:737–755
2. Amstutz AC, Beaul   PE, Dorey FJ, Le Duff MJ, Campbell PA, Gruen TA (2004) Metal on metal hybrid surface arthroplasty: two to six years follow-up study. *J Bone Joint Surg* 86A:28–39

TRIPOLAR HIP ARTHROPLASTY: SAFE SOLUTION FOR PATIENTS AT RISK FOR DISLOCATION

M. Papalia, L. Lucente, M. Papalia

Nuova ITOR (Rome-IT)

Although total hip arthroplasty (THA) remains to be one of the most successful procedures in modern orthopedic surgery, dislocation is one of the major complications that may lengthen patients' hospital stay and even lead to a revision arthroplasty. Many factors can explain the occurrence of instability. They can be differentiated into patient-related, implant-related, and surgery-related factors. Hip implant dislocation is well documented to be more common in specific demographic groups. Advanced age, female sex, prior hip surgery, neuromuscular conditions, cognitive dysfunction, excessive alcohol consumption, and high American Society of Anesthesiologists (ASA) scores are the main patient-related risk factors reported in the literature.

The use of unconstrained tripolar implants has been increasing in recent years. These implants, which provide 2 bearings, were first described by Bousquet. The original design has been altered to improve range of motion, stability, and longevity.

We present our experience with primary THA using such a tripolar hip implant in patients at risk for instability.

SURGICAL APPROACHES TO THA: EVALUATION BY GAIT ANALYSIS

C. D'Arrigo¹, A. Speranza¹, V. Schiavilla¹, M. Vetrano¹, G. Palieri², A. Ferretti¹

¹Policlinico S. Andrea, Università di Roma "La Sapienza" (Rome-IT); ²Ospedale San Giovanni Battista, A.C.I.S.M.O.M., (Rome-IT)

Introduction The choice of surgical technique for total hip arthroplasty (THR) can affect time and postoperative rehabilitation procedures. The aim of this prospective blinded cohort study is to evaluate the functional outcomes of two different groups of patients at 30 days after surgery.

Methods In this study we evaluated the results of Gait Analysis (temporostatal, kinematics, kinetics and electromiography parameters) of two groups of patients operated for THR using two different surgical approaches: a lateral mini-incision approach (transmuscular approach, 15 patients) and an antero-lateral minimally invasive approach (intermuscular MIS approach, 15 patients). All the patients were operated in the same period by the same experienced surgeon. We used in all cases a short hip stem implant with a 36 mm femoral head. All patients received the same postoperative rehabilitation protocol. Patients, physiotherapists, and assessors were blinded to the surgical approach used. Gait analysis was performed at 30 days after surgery.

Results We detected a positive, but not significantly better trend in the minimally invasive antero-lateral group regarding the temporostatal parameters. Regarding the kinematics (hip range of motion in sagittal, frontal and transverse planes), kinetics (hip flexion/extension and abduction/adduction moments) and electromiography parameters (gluteus medius activation pattern and degree of activity) we detected significantly better results in the intermuscular approach.

Conclusions This study demonstrates functional benefits of the minimally invasive antero-lateral (intermuscular) approach respect to the lateral mini-incision (transmuscular) approach in terms of walking ability at 30 days postoperatively.

EARLY DEXA RESULTS WITH A SHORT, ANATOMIC, LATERAL FLARE FEMORAL IMPLANT

C.V. Albanese¹, I. Learmonth², F.S. Santori³

¹Department of Radiological Science, University "La Sapienza" (Rome-IT); ²Avon Orthopaedic Centre (Bristol-UK); ³Ospedale San Pietro Fatebenefratelli (Rome-IT)

Objectives Bone resorption of the proximal femur is a common issue with cementless Total Hip Arthroplasty (THA). One of the main factors that affect bone remodelling is prosthesis design and the resultant stress distribution [1, 2]. Dual energy X-ray Absorptiometry (DEXA) is an accurate and reliable measure of bone mineral density (BMD). We present a longitudinal evaluation of the changes in BMD after THA using a short anatomic femoral implant with a lateral flare, the DePuy PROXIMA™ hip.

Methods A total of 20 patients were recruited as part of an ongoing long-term multi-centre clinical trial. The operations took place between February and October 2006. There were 9 females and 11 males, with a mean age of 59 (range 40–70). The mean weight was 76 kg (range 48–106) and the mean height was 171

cm (range 160–187). DEXA scans were taken at 3, 6 and 12 months post-operatively.

Results 12 month DXA scans were available for 16 patients. All 20 patients were scanned at both 3 and 6 months. 17 of the 20 cases (85%) showed an increase in BMD between 3 and 6 months, 13 cases (81%) showed an increase between 3 and 12 months. Increases in BMD were also noted in all Gruen zones, with zones 2 and 6 showing the highest increases.

Discussion Maintaining or improving the BMD in the early post-operative period after THA is considered crucial in terms of long-term success of the arthroplasty. The design of the DePuy PROXIMA™ hip is such that the load distribution is concentrated in the proximal femur with stress distributed in the medial and lateral aspects of the femoral metaphysis, which in turn leads to a more pronounced increase in BMD in these two areas.

Conclusions The early results of this study confirm that use of the DePuy PROXIMA™ hip can lead to positive bone remodeling in the proximal periprosthetic bone.

References

1. Albanese CV, Rendine M, De Palma F, Impagliazzo A, Falez F, Postacchini F, Villani C, Passariello R, Santori FS (2006) Bone remodeling in THA: a comparative DXA scan study conventional implants and a new stemless femoral component. A preliminary report. *Hip International* 16(3):S9–S15
2. Santori N, Albanese CV, Learmonth ID, Santori FS (2006) Bone preservation with a conservative metaphyseal loading implant. *Hip International* 16(3):S16–S21

HIP 2

CERAMIC: WEAR RELATED TO DIAMETER, CLEARANCE AND MICROSEPARATION

F. Macchi, T. Pandorf

CeramTec AG, Medical Product Division (Plochingen-DE)

Objective Large diameter ceramic bearings are of increasing interest due to the enlarged range of motion, enhanced stability of the artificial hip joint, and reduced risk of dislocations. Larger diameter hard on hard bearings may as well change the wear characteristics due to larger wear areas or different lubrication behaviour from changed diameter tolerances as known from Me-Me large bearings. But not only hard-on-hard bearings are of interest. With new low wear highly cross-linked polyethylene, wear behaviour of large ball heads against XPE liners is in focus.

Material and Methods Three different wear studies were conducted: (1) *Ce-Ce*, Alumina matrix bearings 40 mm and 44 mm with different diameter tolerances were tested according to DIN EN 14242. Roundness of the ball head and insert as well as clearance of the bearing partners have been varied; (2) *Ce-XPE*, Mean volume change rates have been compared between a 36 mm BIOLOX® forte ceramic ball head and CoCr ball heads. Both heads articulated against a XPE liner; (3) *Ce-Ce*: 36 mm diameter bearings in microseparation mode with two different ceramic materials were tested, one a pure alumina, the other an alumina matrix composite.

Results Large ceramic bearings have a very low wear rate. They are less sensitive to manufacturing tolerances like sphericity and clearance when compared to large metal on metal bearings. The influence of the clearance on the wear rate is negligible. Using a ceramic ball head against a highly crosslinked polyethylene liner reduces the wear rate by 40% compared to metal ball heads. Even in microseparation mode the wear volume is very low compared to other bearing materials. The wear volume is similar to previ-

ously performed microseparation wear studies of 28 mm bearings. The wear volume depends on the used combination of the two different bearing materials. The alumina matrix composite (BIOLOX®delta) has 6 fold less wear when compared with the alumina couple.

Conclusions The superior wear characteristics of large ceramic bearings have been proven in all tribological test setups. All these findings support the enhanced wear behaviour of large ceramic ball heads. This is especially valid for the alumina matrix composite BIOLOX® delta. Superior wear behaviour and additional strength are the reasons that this material will be used in the future designs of large diameter ceramic on ceramic bearings. The use of ceramics in a hip replacement will significantly reduce the risk of particle induced osteolysis.

PATIENT PERCEIVED QUALITY OF LIFE AFTER TOTAL HIP ARTHROPLASTY: ELECTIVE VERSUS TRAUMATOLOGICAL SURGERY

A. Aprato¹, W. Daghighi¹, R. Matteotti¹, F. Caranzano², P. Pautasso, A. Massè¹

¹Pelvic Surgery Department, Orthopaedic and Traumatological Hospital of Turin, University of Turin (Turin-IT); ²Orthopaedic Department, Maurizio Umberto I Hospital of Turin, University of Turin (Turin-IT); ³Department of Radiology, Orthopaedic and Traumatological Hospital of Turin, University of Turin (Turin-IT)

Total hip arthroplasty (THA) is beneficial and effective for the treatment of either hip osteoarthritis either hip fracture. The aim of our study was to evaluate and compare patients health-related quality of life after THA for osteoarthritis (group B) and femoral neck fracture (group A). Study groups were compared as to age, results of WOMAC and SF-36 tests, limb length discrepancy (LLD) by independent group *t*-test. Correlations between LLD and results obtained at WOMAC test were performed.

117 patients were enrolled; respectively 52 in group A and 65 in group B. The 2 groups were similar as to age, type of implanted stem and sex ($p < 0.05$). Mean follow-up was 2.4 years for group A and 2.3 years. Mean total WOMAC score was found higher in group A in all examined items. Fractured patients obtained better results than arthritis patients in 3 major items of SF-36. All other major items were higher for elective patients. Mean LLD was -0.18 cm for elective group and +0.52 cm for fractured group but no significant difference was evidenced. Correlation tests do not indicated a statistically significant linear relationship between LLD and WOMAC score in both groups.

According to our data, patients who received THA for arthritis have better perception of quality of life than traumatologic patients and LLD alone can't be considered as an indicator of patient dissatisfaction or clinical bad result after a 2 years follow-up.

A NEW CLASSIFICATION FOR PROXIMAL FEMUR BONE DEFECTS IN CONSERVATIVE HIP REVISION

F. Casella, F. Favetti, M. Papalia, F. Falez

Orthopaedic and Traumatologic Department, S. Spirito in Sassia Hospital (Rome-IT)

Introduction Indications to total hip arthroplasty have widened, during the last two decades, to young and active patients with end stage arthritis. Principles of bone preservation have pushed many surgeons to implant conservative femoral components.

Despite an overall good survivorship and clinical outcomes, the failure rate reported is making the revision of a conservative femoral component a non-occasional procedure.

Methods During conservative femoral component revisions, we analyzed proximal bone stock preservation, considering the type of original component removed, etiology of failure and timing of revision.

Results We identified 4 patterns of proximal femoral changes (Type I–IV) with Type II pattern divided into two sub-groups. We suggest, for each of them, a revision strategy directed toward a “conservative revision procedure” using conservative or primary component. Out of our 11 cases, none underwent further revision due to mechanical failure (follow-up ranging from 3 to 35 months). We had only one case of re-operation due to early septic loosening.

Conclusions If literature offers well-established guide-lines to femoral revision of conventional stems, there is, on the other hand, a lack of data about revision strategies in presence of failed conservative implants. Although the follow-up of our procedures is still too short (19.54 months) to give time-tested conclusions, we would give a suggestion: a conservative hip arthroplasty is not a “one shot” opportunity for young and active people. A “conservative revision” is a valid option for at least a part of them, who has experienced an early failure of primary procedure.

LONG TERM EVALUATION OF REVISION HIP ARTHROPLASTY WITH A CEMENTLESS STEM (S-ROM)

G. Logroscino, V. Ciriello, E. Pagano, M. Venosa, C. Conti, G. Magliocchetti Lombi

Department of Orthopaedics, Catholic University (Rome-IT)

Background Revision hip arthroplasty (THR) is a difficult challenge in reconstructive hip surgery due to severe femoral bone loss. Long and very invasive stems are often required and bone stock is furthermore jeopardized. Moreover, the anatomic joint geometry is very difficult to be restored and modular stems seem to be the best solution to this problem. It is a long debated question whether cementless or cemented stems is the best solution in revision surgery in THR.

Objective We aim to evaluate the effectiveness at a long term follow-up of a modular cementless stem in THR.

Material and Methods This study describes 38 hips that underwent cementless femoral revision arthroplasty between 1997 and 1999 with a proximal porous coated, modular titanium alloy stem (S-ROM, De PuyJohnson&Johnson). According to Paprosky's femoral defect classification, the patients were classified in: type I (17%) type II (39%) type III (33%) and type IV (11%). Twenty-two patients were available for the final follow-up evaluation at 7 to 10 years (average 8.4 years). All the patients were evaluated clinically (HHS, WOMAC, SF-12 and Satisfaction Test), comparing pre with postoperative results. Radiographic analysis was performed based on the Engh's criteria.

Results HHS improved from 32.8 to 76.2. Twenty-one stems presented stable bony ingrowth, one was stabilized by fibrous tissue. Mechanical failure rate and re-revision rate were zero. Eight-year survival rate was 100%, with re-revision as endpoint.

Conclusions Cementless THR showed excellent results at a long term follow-up. A correct preoperative evaluation of bone loss and residual bone stock before surgery are indicative to determine the best surgical choice. The S-Rom stem demonstrate to obtain good primary stability even in the presence of severe bone loss. No complications were imputable to the S-ROM implant that demonstrates to be an effective implant to reduce pain and restore hip function in revision hip arthroplasty surgery.

REVISION TOTAL HIP ARTHROPLASTY: FEMORAL PROBLEMS

M. Papalia¹, G. Panegrossi¹, F. Casella², F. Favetti¹, C. Barresi², F. Falez¹

¹Santo Spirito Hospital (Rome-IT); ²Rome American Hospital (Rome-IT)

Femoral revision total hip arthroplasty is a complex procedure with many potential problems and pitfalls that may adversely affect the patient's final outcome. There are multiple options available for reconstruction including fixation with cement, cementless fixation with either a proximally load bearing stem or a cementless, full porous coated stem that gains primary fixation in the diaphysis, impaction grafting, allograft prosthesis composites or proximal femoral replacing prosthesis.

The ability to preoperatively determine the most appropriate option for reconstruction greatly assists with ensuring that the appropriate implants and instruments are available at the time of surgery.

In addition to these technical issues, preoperative planning can be challenging and with multiple reconstructive options available, the decision-making process can be complex. We present our experience in femoral reconstruction during revision total hip arthroplasty.

INFECTION AFTER TOTAL HIP ARTHROPLASTY: PERSONAL EXPERIENCE AND MANAGEMENT PROTOCOL

C. Doria, L. Tidu, F. Milia, A. Ruggiu, A. Zachos, P. Lisai, P. Tranquilli Leali

Clinica Ortopedica (Sassari-IT)

Deep infection occurring in total hip arthroplasty (THA) is one of the most devastating complications of an otherwise highly successful operation. Infection rates have been reported in approximately 0.5% to 1% of general population. Patients with rheumatoid arthritis or diabetes mellitus have a greater probability of developing infections. Authors stress the importance for patient and surgeons to identify risk factors and to be aware of the importance of early diagnosis and treatment. Infections and total hip arthroplasty can occur early, within the first 4 weeks, or later, after the 4th week. There are two types of etiology for early infections: local postoperative contamination and haematogenous. Both types present with local inflammation of acute onset and systemic toxicity. Frequently early postoperative infections are associated with persistent haematoma and drainage and occur in patients who have difficulty in regaining range of motion. Haematogenous infection represents haematogenous seeding of the joint from another primary site of infection. Finally, the circumstance in which positive intraoperative culture is present in the setting of presumed aseptic etiologies is discussed along with the treatment of many variables including infection timing, bacteriology, implant stability, soft tissues concern and other host conditions. Orthopaedic surgeons, microbiologists and infectious disease physicians should work in a dedicated interdisciplinary team for optimal managements. Treatment options include chronic antibiotic suppression, debridement with prosthetic retention, one-stage revision and two-stage revision. Amputation should not be considered as a treatment option but as a salvage procedure for patients with life-threatening sepsis combined with massive soft tissue and bone loss. If infection is diagnosed within the first month and the implant is stable, is reasonable to perform a thorough debridement of the hip and only polyethylene socket replacement; otherwise chronic infections need to be treated by

prosthetic components removal with a two-stage procedure using a spacer. After a thorough debridement an antibiotic-loaded cement spacer block is implanted as a temporary device into the joint (6/8 weeks), providing high concentration of local antibiotic delivery and maintenance of joint space, improving patient comfort between stages. The patient is treated with intravenous antibiotics for 6/8 weeks and finally a delayed reimplantation is performed.

ANTIBIOTIC-LOADED PREFORMED PMMA SPACER FOR TWO-STAGE REVISION OF INFECTED TOTAL HIP REPLACEMENTS

B. Magnan, D. Regis, A. Sandri, A. Costa, P. Bartolozzi

Orthopaedic Department, University of Verona (Verona-IT)

Introduction In two-stage revision of an infected total hip replacement a preformed temporary antibiotic-loaded polymethylmethacrylate spacer may be required in order to allow weightbearing and joint motion while ensuring antibiotic local release.

Methods 29 patients with infected hips were treated by a two-stage procedure including removal of prosthesis and implantation of a spacer. The device comprised a stem with 3 available head sizes pre-coated by bone cement supplemented with gentamicin (2.5% w/w) and vancomycin (2.5% w/w). Joint motion and weightbearing were allowed when the bone stock ensured an adequate stability to the spacer. Systemic antibiotics were administered for 8 weeks. The spacer remained *in situ* for an average of 155 (range 70–272) days. Reimplantation was performed when recovery of clinical and serological signs of infection was obtained. Patients' evaluation included clinical assessment (HHS), standard X-ray and laboratory parameters.

Results Mean follow-up was 52 months (range 36–100). Healing of the infection was obtained in 27/29 cases (93.1%). 5 patients required resection-arthroplasty (2 persistent infections, 2 inadequate bone stock, 1 recurrent infection). In 4 cases the spacer dislocated, being treated by non-surgical reduction. The reimplanted patients (24) showed no clinical or laboratory signs of infection recurrence, with a mean HHS score of 79 (range 53–100); no radiographic signs of loosening were observed.

Discussion The use of a preformed antibiotic-loaded spacer in two-stage revisions, allowing a local antibiotic release together with some degree of joint motion, appears to enhance infection's treatment improving patients' quality of life and functional recovery.

PRELIMINARY RESULTS OF TRABECULAR METAL PRIMARY HIP PROSTHESIS

A. Capone¹, G.P. Jelmoni², U. Tarantino³, C. Manzini⁴, E. Martucci⁵, G. Zanotti⁶, G. Guido⁷, M. Lisanti⁷, P. Candela⁸

¹Cagliari-IT; ²Pavia-IT; ³Rome-IT; ⁴Giussano, Monza-IT; ⁵Bologna-IT; ⁶Lugo di Romagna, Ravenna-IT; ⁷Pisa-IT; ⁸Paola, Cosenza-IT

Objective The Trabecular Metal Primary (T.M.P., Zimmer) hip prosthesis brings the distinctive properties and clinically proven benefits of trabecular metal technology to a bone conserving and proximal loading stem design. The geometry of the stem presents a 14° proximal A/P taper and a smooth distal 3° taper to optimize proximal load transfer and to minimize stress shielding. The 23.5° neck resection angle retains proximal bone which increases surface area contact with trabecular metal material, enhances rotational stability and long-term biological fixation. A multi-centre prospective study was conducted to evaluate the preliminary clinical and radiographic results in 200

patients undergoing primary total hip arthroplasty between November 2006 and November 2007.

Material and Methods The mean age of the 200 patients at the time of arthroplasty was 67 years (range 44–90 years). 61% of the patients were female and 39% were male. The principal pre-operative diagnoses were osteoarthritis (74%), femoral neck fractures (15%) and osteonecrosis (3%). These patients had a T.M.P. femoral component and an uncemented acetabular component. There were 48% modular Trabecular-Metal, 22% Trilogy, 21% Durom and 9% various acetabular components implanted. The size of the femoral head was 36 mm in 53% of the hips, 28 mm in 21% and 32 mm in 8%. The articulation surfaces were metal-on-polyethylene in 68%, metal-on-metal in 24% and ceramic-on-polyethylene in 8%. Because of the multicenter nature of this study, we used standardized forms for all data and these forms were returned to a central location for compilation and analysis (GAP software). Clinical and radiographic evaluations were performed preoperatively and postoperatively at 1 month, 3 months, 6 months, and 12 months. Clinical parameters included a composite Harris Hip Score (HHS) for functional assessment. The radiographs were evaluated for the presence of radiolucent lines, periosteal cortical hypertrophy and cancellous condensation in the zones around the femoral component as described by Gruen. Subsidence of the implant and heterotopic bone formation also was evaluated. A stem was considered stable with osseous ingrowth if there were an absence of radiolucent lines and an accretion of endosteal bone (spot welds) in trabecular metal-coated zones. In addition, two of the participating surgeons (A.C. and U.T.), conducted serial DEXA studies to evaluate femoral bone mineral density (B.M.D.).

Results We evaluated the results of 85 hips at mean follow-up of 12.2 months (range 10.2–16 months). The mean preoperative average Harris hip score was 42.4 points. It improved to 83 points by 6 months postoperatively and to 85 points by the last follow-up (range 73–100). At 6 months follow-up five patients (5.8%) reported mild thigh pain during walking. Radiographic evaluation demonstrated at 12 months follow-up no femoral fixation failure. All stems had bone ingrowth fixation. No patient had evidence of progressive lucent lines or stress shielding. The majority of patients had evidence of spot welds visible after 6 months in the trabecular metal coated portions of the stem. Two patients (2.3%) had heterotopic bone formation (Brooker 1 and 2) without functional impairment. Dual energy X-ray absorptiometry performed at 6 months postoperatively reported an average BMD loss of 6.2% in Gruen Zone 1 and 16 % in Gruen Zone 7.

Conclusions Serial radiographs following TMP stem implantation have consistently displayed signs of bone ingrowth and exhibited no progressive radiolucencies in a group of 80 patients with mean age of 67 and with primary diagnosis of osteoporotic femoral neck fractures in 15% of the hips. The proximal excellent implant fixation minimizes stress shielding, reduces the incidence of thigh pain and femoral bone loss. Longer follow-up is necessary to evaluate the performance of the proximal trabecular metal coating for improving clinical results and implant survival of uncemented stems even in patients with poor bone quality.

TRAUMATOLOGY 1

FUNCTIONAL OUTCOME AND QUALITY OF LIFE AFTER PELVIC RING INJURIES

A. Gallo¹, F. Sacco¹, M. Favuto², M. Dagna¹, A. Masse², A. Biasibetti¹

¹Dipartimento di Traumatologia e Fissazione Esterna, CTO (Torino-IT); ²SCDU Ortopedia e Traumatologia, San Luigi (Orbasano-IT)

Introduction Pelvic ring injuries are high-energy trauma related events and are often associated with multiple concomitant injuries. Management and treatment of these patients may require long periods of bed-rest and rehabilitation, but long-term functional results can be poor and negatively affect the quality of life of the patient.

Aim Evaluation of the muscle-skeletal, urologic and sexual functional outcome and quality of life after unstable surgically treated pelvic ring injuries.

Material and Methods 45 patients with unstable pelvic ring injury surgically treated between December 2001 and July 2007 were reviewed. Average patient age and follow-up time were respectively 44 years and 25.5 months. A new numerical scoring system was developed based on the following factors: pain, sitting, walking, work ability, and urinary and sexual dysfunction.

Results Only 28% of the patients obtained an excellent-rated functional score and quality of life. 72% of the patients have a reduced muscle-skeletal functional score, while respectively 30% and 45% have urinary and sexual dysfunctions. Whereas muscle-skeletal functions frequently improve with time, urologic and sexual problems are, if present, not only often severe, but also often remain stable over the years.

Conclusions Pelvic ring injuries may negatively affect the quality of life of the patient. Muscle-skeletal, urologic and sexual dysfunctions must always be assessed and carefully treated. A multidisciplinary, comprehensive approach in acute care and during the follow-up period is fundamental to ensure the patient the highest quality of life.

ANTERIOR PELVIC RING FRACTURES: A PROPOSAL FOR A VARIANT OF OSTEOSYNTHESIS OF THE PUBIC SYMPHYSIS

R. Spagnolo¹, D. Capitani¹, A. Fiore¹, F. Sala², F. Pace², L. Mazzoleni²

¹Ospedale Niguarda Ca' Granda (Milan-IT); ²Scuola di Specializzazione in Ortopedia e Traumatologia, Università degli Studi di Milano (Milan-IT)

In the treatment of the pelvic fractures it is important to consider the stability or instability of the fracture and the hemodynamic situation of the patient. The most common causes of these traumas are traffic injuries and fallen by heights. Besides all the possible consequences to the bone structures of the pelvis there is the possibility of injuries to the neuro-vascular structures, bladder, abdominal structures and in literature the mortality is from 10% to 50% in case of associated open lesions, head traumas, hypotension and coagulopatias. There are many pelvic fracture classifications, but the most common used are Tile's (A stable, B rotational instability, C vertical share) and Young-Bourgess (antero-posterior traumas, lateral and vertical). In the first phase conventional X-ray in AP view and CT scan of the pelvis are executed to evaluate also visceral or vascular lesions.

The treatment of instable pelvic lesions could be subdivided in two phases: the acute one (resuscitation phase), and the one of the haemodynamically stable patient (reconstruction phase). In the first phase the primary role is to stabilize the patient fracture which can be obtained with the pelvic fascia, c-clamp or external fixation for the open-book fracture or for the antero-posterior compression traumas; these kind of treatment have the duplex effect to reduce the fracture mobility and the pelvic volume from virtual to real with the reduction

of retroperitoneal haematoma). In type B fractures (Tile) we use an external fixator anchored to iliac crest percutaneously, while in case the sacro-iliac joint would be involved, we apply both the external fixator and transcheletric traction to maintain the reduction of the vertical share. In case the patient would be still haemodynamically unstable, an arteriography is the gold standard thanks to embolization.

Once the patient is stable it has to be decided which kind of treatment would be the best: going on with external fixation or converting in internal fixation. Between 2002 and 2007 at Niguarda Trauma Center 86 patients with pelvic ring fractures has been treated and our article is referred to stable patients who need definitive treatment. Type B fractures have been synthesized with an anterior approach, while vertical share fractures with a combined anterior and posterior approach. Since 2005 the first two authors have treated 16 patients and made a modification in the positioning of the anterior screws for the stabilization of the pubic symphysis. Classically the synthesis of the symphysis is executed with 2 plates of 3.5 or 4.5 mm, one anterior and the other sovrapubic, where the screws are positioned from anterior to posterior. In the 16 considered cases we have positioned just 2 anterior screws, one for each pubic branch, in the conviction of a better respect of the physiological forces lines. All the screws have a length of 55 to 65 mm. It is very important that during the screw positioning the pubic notch is well visualized and an inclination of 20–25 degrees as regards to pubic symphysis is maintained. The plate could have a 3 hole lengths for a better choice of where to position the contralateral screw.

EXPERIENCE WITH TAYLOR SPATIAL FRAME IN NIGUARDA CA' GRANDA HOSPITAL SINCE 2006

F. Sala, R. Spagnolo, F. Castelli, E. Marinoni, U. Valentinotti, G.A. Lamaida, D. Capitani

Orthopaedic and Trauma Department, Ca' Granda Niguarda Hospital (Milan-IT)

Background The Taylor Spatial Frame (TSF) represents a very powerful tool with its hardware and software program [1]. This external fixator is suitable to correct lower limb long bone fracture, deformity, malunion and non-union using the Ilizarov principles [2, 3].

Material and Methods Since January 2006 till February 2008 we have applied 29 TSF in 26 patients in our hospital in Milan. There were 22 male and 4 female with a mean age of 41.5 years (range 9–84). The bone segments were: femur (6), tibia (21), humerus (1) and 1 foot. Two male had unilateral femoral and tibial injuries. A 78-year-old male had a septic tibial non-union and an atrophic humeral non-union. The femoral group had: 2 bifocal bone transport (20 and 10 cm) in pseudoarthrosis with bone loss; 1 lengthening (3 cm) with double varus and procurvatus post traumatic deformity correction; three femoral cases were trauma (management of displaced fracture). The tibial group had: 3 open fractures, 2 post traumatic deformity corrections, 1 "rigeneratus" correction, 2 monofocal treatment in pseudoarthrosis, 13 treated with bone transport in non-union (9 with infection). Different techniques of lengthening were utilized: 7 trifocal, 5 bifocal and 1 bifocal + lengthening and foot correction. The mean number of operations before the application of tsf was 2 (range 0–6 operations). A 17-year-old female with fork spine foot deformity was treated.

Results 20 patients completed their treatment and removed the external fixators. Two patients were excluded from the study. An 84-year-old with tibial septic nonunion treated with monofocal technique died of heart failure two months after the date of implant frame. A second male, 52-year-old treated by trifocal transport, with cutaneous squamous cell carcinoma in cronic tibial septic non-union was amputated at the thigh. One male with 20 cm femoral bifocal bone transport, healed at docking site point, is waiting for regenerate bone formation. 4 tibial bone transport are in treatment after docking site revision. All 20 patients were

examined. 1 tibia fracture had a second treatment with bifocal bone transport in other hospital in which he took care of pancreas carcinoma. The average time of TSF wearing was 9.5 months (range 4 ½–22 months). Patients 19 (20) had gradual correction of their deformity, success in bone transport and fracture consolidation. Eight tibial bone transport in non-unions were lengthened from 3 to 10.3 cm (average, 6.5 cm). The average time of treatment was of 13.8 months (range, 10 to 22 months). The average time of healing of the docking sites was 9.5 months (range, 7 to 14 months). Hypertrophic nonunion had monofocal treatment with gradual compression, fibular osteotomy and resection (2 cm) and angular correction. It healed after 5 months.

Conclusions Spatial frame is the technology of the future in Orthopaedic and Trauma Surgery. It is not only for deformity correction, but also for closed a perfect reduction and fixation without having to expose the patient to all disadvantages of open surgery. In addition to having all the advantages of external fixation, it has all the advantages of post operative adjustability at any time before the bone consolidation. It is very easy and very fast to apply for trauma patient.

References

1. Taylor JC (2002) Six-axis deformity analysis and correction. In: Paley D (ed) Principles of Deformity Correction. Springer, Berlin Heidelberg New York, pp 411–436
2. Binski JC (2002) Taylor Spatial Frame in acute fracture Care. Techniques in Orthopaedics 17(2):173–184
3. Feldman DS et al (2003) Correction of tibial malunion and non-union with six-axis analysis deformity correction using the TSF. J Orthop Trauma 17(8)

DECISION MAKING INITIAL STABILIZATION WITH EXTERNAL TEMPORARY FIXATION IN EMERGENCY AND CONVERSION TO CIRCULAR EXTERNAL FIXATION AS DEFINITIVE TREATMENT

F. Sala, R. Spagnolo, F. Castelli, D. Capitani

Orthopaedic Department, Ca' Granda Niguarda Hospital (Milan-IT)

Background The treatment of multi-injured patients requires initial stabilization of general conditions and vital parameters [1]. The first stage in orthopedic management of the fractures in trauma involves stabilization of the bone segments to reduce blood loss and allow nursing. External fixators are fast, versatile and essential in the emergency situation in cases of multiple fractures, especially with soft tissue loss. According to damage control orthopedics (DCO) concepts, it is possible to replace an external fixator (EF) with internal synthesis (ORIF) after a period of time to reduce the risks of ORIF. However, surgery can be difficult to perform and pin sites can be the source of bone infection, in which the EF as a definitive treatment option may be considered [2, 3].

Material and Methods In trauma surgery, instability of the hardware, fractures near the joint, frame extending across the knee and the ankle, initial fixation was converted to definitive treatment with circular frames according to the Ilizarov method. Fourteen patients (2 female and 12 males; age 24 to 80 years, average age 43.4 y/o) were treated with various circular frames as definitive treatment: Ilizarov (2), Sheffield (7), Taylor Spatial Frame (TSF) (4) and TrueLok (1) between November 2002 and December 2007 in multiple injured patients with ISS > 20. Seven cases were femoral and seven tibial. The femoral group had four knee spanning fixator configurations and three unilateral external fixators. The tibial group had 4 unilateral frames, 1 hybrid EF, 1 across the knee EF and 1 across the ankle EF. Five patients had temporary femoral and tibial hardwares in the same side. Three patients had unilateral tibial and femoral fractures.

Results All patients achieved consolidation. The mean duration of femoral EF was 7.6 months (5–9 months). One bone loss in a distal femoral shaft treated with Sheffield EF had lengthening (5 cm) after acute shortening. Two patients had gradual distal femoral fracture reduction and a mechanical axis correction by TSF. Three patients with tibial bone loss had 2 trifocal bone transport (17.5 and 9 cm) and 1 bifocal bone transport 5 cm. The TSF had no additional pre-operative planning and major post-operative frame adjustments. The intra-operative device was easier for the TSF.

Conclusions Circular frame osteosynthesis following initial EF, is a reliable and effective strategy for treatment in severe open femur and tibia fractures and post traumatic reconstruction.

References

1. Lovisetti G, Bettella L, Sala F (2006) Treatment of complex acute femoral fractures with Ilizarov Frame. 16th Annual Scientific Meeting of LLRS Asami-North America. 21–23 July 2006, San Diego USA
2. Rozbruch SR, Weitzman AM, Watson JT et al (2006) Simultaneous treatment of tibial bone and soft-tissue defects with the Ilizarov method. *J Orthop Trauma* 20(3):194–202
3. Tucker H, Kendra JC, Kinnebrew TE (1992) Management of unstable open and closed tibial fractures using the Ilizarov method. *Clin orthop* 280:125–135

DIAPHYSIS FRACTURE OF THE FEMUR (VANCOUVER TYPE B) OF HIP PROSTHESIS: OUR EXPERIENCE IN 60 CASES

P.B. Squarzina, S. Luppino, A. Difino, D. Sassi, G. Richeldi, F. Tarantino

U.O. Ortopedia e Traumatologia, Nuovo Ospedale Civile S. Agostino Estense (Modena-IT)

We retrospectively reviewed 60 periprosthetic fractures of the femur (hip arthroplasty), treated in our centre from January 1995 to June 2007. One case was bilateral and 2 cases consisted of new fractures. The average age was 73 years (53–94). There were 39 female and 18 male patients. According to the Vancouver classification, 28 cases were type B1, 28 cases were type B2 and 4 cases were type B3. Initial treatment was conservative in 4 cases and surgical in 56 cases: we performed osteosynthesis in 24 patients (type B1) and revision in 32 cases (type B2 or B3). One patient died in the immediate postoperative course (revision) and in one case of infection (revision) we performed the removal of the prosthesis. Fractures healed in all the other cases (55 with initial treatment, in 3 cases we performed a new treatment due to failure of the initial procedure). We observed local postoperative complications in 7 cases (12%): deep infection (3 cases), loss of synthesis (1 case) loss of reduction of the fracture in the cast (1 case), dislocation (1 case), femoral stem loosening (1 case). After a mean follow-up of more than 5 years, we evaluate 48 fractures (47 patients): of those, the initial treatment was conservative in 3 cases and surgical in 45 cases (26 revision and 19 osteosynthesis). Outcome scores, according to the criteria of Beals and Tower, in the revision group were excellent in 20 patients, good in 5 patients and poor in 1 patient; in the osteosynthesis group results were excellent in 16 patients, good in 2 patients and poor in 1 patient. There was an excellent outcome in 2 of the 3 cases initially treated conservatively; in the third case, the outcome was excellent only after revision. Our results suggest that conservative treatment is indicated only in selected cases, with surgery being the best procedure; if the stem is loose, revision with modular stem uncemented with distal grip is indicated, if there is no mechanical loosening a stable osteosynthesis using plate and screws or cerclage, sol-

idal to the plate is indicated. These procedures are complex, with important morbidity, but malunion are rare and, usually, there is a satisfactory functional outcome.

TRAUMATOLOGY 2

TREATMENT OF THE BICONDYLAR FRACTURES OF THE PROXIMAL TIBIA WITH LISS

P.B. Squarzina, C. Zapparoli, F. Fabbri, U. Fregni, F. Bolzani

U.O. Ortopedia e Traumatologia, Nuovo Ospedale Civile S. Agostino Estense (Modena-IT)

Twenty-two bicondylar fractures (Schatzker type V or VI) in 21 patients, mean age 49 years (range 20–83 years), were treated between 2006 and 2007. Injury occurred in low energy trauma in 4 cases (mean age over 65 years) and in high energy trauma in 18 cases (8 polytraumas). Twenty fractures were closed (2 type 0, 10 type 1 and 8 Tscherne type 2) and 2 were open (1 type 3A and 1 Gustilo type 3C). One case was bilateral. The average delay between the trauma and operation was 4 days (range 1–25 days); external bridging fixation on the knee (damage control) was initially performed in 6 cases. All patients were treated with the LISS and MIPO techniques (in association with sub meniscal arthrotomy in 6 cases). In 14 cases we performed medial osteosynthesis with canulated screws (11 cases) or LCP plate (3 cases) in association with lateral osteosynthesis with LISS.

We observed good reduction (intra-articular step-off less than 2 mm or malalignment in the frontal or sagittal plane of less than 5 degrees) in 11 cases (50%), fair in 8 cases (36.5%) and poor in 3 cases (13.5%). All patients had undergone immediate mobilization and achieved complete weight-bearing after a mean of 12 (8–16) weeks. One case was lost to follow-up, and the remaining 21 cases were followed, mean follow-up 12 months (range 6–20). All fractures healed in a mean time of 12 (8–20) weeks; average ROM was 112°. Complications observed included a loss of post-operative reduction in 2 cases (9%) and symptomatic hardware irritation related to the superficial position of the plate in 4 cases (21%). No infections, pseudoarthrosis nor skin necrosis were observed. LISS removal was attempted in 5 cases (43 screws): we observed seizure in 4 screws (9.5%) resulting in the inability to remove 1 plate.

Although LISS is a rather complex technique with a significant learning curve and a requirement for expensive hardware, its use in conjunction with the MIPO technique for complex tibial plateau fractures is valid, providing good reduction and stable, low invasive fixation. The absence of major complications such as infection or skin necrosis is attractive. The incidence of screw seizure can inhibit hardware removal.

TREATMENT OF FEMORAL FRACTURES WITH INTERNAL FIXATOR

P.B. Squarzina, L. Castagnini, G. D'Angelo, U. Baschieri, C. Facchini, L. Monteleone

U.O. Ortopedia e Traumatologia, Nuovo Ospedale Civile S. Agostino Estense (Modena-IT)

Between 2004 and 2007, 43 fractures of the femur (41 patients; 25 female, 16 male; mean age 18/95 years), were treated with an internal fixator (LISS 39 cases, LCP DF 4 cases); one case was bilateral and

another bifocal. Following the AO classification, 16 fractures were type 33 A, 18 were type 33 C and 7 (all periprosthetic) were type 32 A1; moreover, we performed a "reverse" plate position osteosynthesis in 2 cases with comminuted subtrochanteric fracture. 20 cases were caused by high energy traumas (17 of them were politraumas) and 21 were caused by low energy traumas. There were hardware implants in the fractured femur in 17 patients (40%): of these, 10 patients had hip arthroplasties, 5 patients had total knee arthroplasty and 2 other patients had hardware for osteosynthesis. 23 fractures were treated with MIPO and 20 with ORIF. In 7 cases (16.5%) hardware was not correctly positioned (in 1 case the plate was positioned too far from the femur, in 2 cases with prominent implant proximally, 4 cases has incorrect positioning of the screws). All patients had undergone immediate mobilization and complete weight-bearing after 2–3 months. Follow-up was achieved in 39 fractures of 37 patients (2 cases were lost to follow-up and 2 patients had passed away) for a mean of 13 months (5–42). All but one fracture (1 case of pseudoarthrosis, 2.5%) healed at a mean of 3 months. In 4 (10.5%) cases, fracture alignment were unsatisfactorily united (2 cases with procurvatum greater than 10° and 2 cases with valgum greater than 5°). Average ROM was 103°. We observed no cases of screw seizure while performing plate removal in 4 patients (4 plates, 31 screws). We conclude that, although the learning curve is high, internal fixators represent a valid hardware for the treatment of: (1) extraarticular fractures of the distal femur (33A), especially those with small and osteoporotic distal fragments; (2) intraarticular fractures of the distal femur (33C), especially complex (C2 and C3); (3) fractures 33 A or C in presence of hardware proximally (hip arthroplasties, cervical-trochanteric nails) or distally (total knee arthroplasties); (4) periprosthetic fracture of the diaphysis; (5) selected cases of complex proximal fractures, as an alternative to more invasive traditional plates, in which intramedullary nails may not guarantee adequate stability.

TREATMENT OF DISTAL TIBIA FRACTURES WITH MIPO TECHNIQUE: CONSIDERATIONS AFTER A 3-YEAR EXPERIENCE

R. Spagnolo¹, D. Capitani¹, M. Bonalumi¹, A. La Maida¹, B. Bono¹, F. Pace², L. Mazzoleni²

¹Ospedale Niguarda Ca' Granda (Milan-IT); ²Scuola di Specializzazione in Ortopedia e Traumatologia, Università degli Studi di Milano (Milan-IT)

The fractures of the distal tibia represent 7–10% of all tibial fractures and they usually are the result of high energy traumas such as traffic accidents or fall from a height; in these cases the axial compression causes complex articular fractures characterized by metaphysis break and bone loss. A better prognosis is given in case of low energy traumas. A great importance is to be given to the evaluation of the soft tissues condition like vascularization and the skin covering, in fact they can determine the choice of the treatment together with the articular surface situation and if underevaluated they can finally give some complications. The study evaluates the results of the surgical treatment of distal tibia fractures, using minimally invasive plate osteosynthesis (MIPO) technique. This kind of technique (first described by Helfet in 1997) can give important advantages, above all under the biological point of view. In fact it reduces the soft tissue trauma respecting the fracture haematoma and the bone fragments vascularization. We treated in our unit 18 patients with distal tibia fractures with the MIPO technique. The fractures, intra-articular or extra-articular, were classified according to the AO classification. The cases studied did not involve open fractures or cutaneous lesions and we excluded the C3 and B2 fractures, for which traditional osteosynthe-

sis is preferable. At the arrive in the hospital the displaced fractures have been treated with transcalcaneal traction to maintain the axial alignment and the length of the limb. The surgery has been always performed within 96 hours. The technique still provides the reduction and the synthesis of the fibula with one-third tubular plates, before the stabilization of the tibia. No external fixator was applied to obtain a reduction during surgery in any of the cases studied and this thanks to the synthesis of the fibula, which allows a perfect reduction of the tibia and a correct length of the limb. A small distal incision of about 2.5 cm is performed to the medial malleolus, while a proximal one is performed to the fracture along the medial edge of the tibia. In case of articular fractures, attention is to be paid to gain a perfect reduction of the surface and if necessary also an arthrotomy is to be performed and the fracture has to be fixed with 3.5 mm cortical screws. We always used 4.5 mm plates which are previously moulded and stabilized with 4.5 mm cortical screws. No tourniquet was used in any of the cases and this was to avoid stress caused by vascular perfusion reduction in an anatomical district at risk. Moreover this allows a better antibiotic spread. We had one case of superficial wound infection in a diabetic patient with the dehiscence of the surgical wound than solved with the correct consolidation of the fractures; a malunion with more than 5 degrees of varus, one case of asymptomatic breaking of the distal screws. On the whole the outcomes were positive, thanks to a correct clinical indication. In conclusion we think that two are the elements that direct the choice regarding the type of approach and the type of device for the synthesis. The first is the condition of the skin, as far as its integrity is concerned, and the second is the articular condition, as far as the comminution and the number of fragments are concerned. Therefore we need to choose a synthesis that can guarantee a good outcome and can avoid dreadful complications and MIPO is a valid technique when used correctly and by experts.

COMPLICATED FRACTURES OF THE LOWER LIMB: OUR EXPERIENCE

C. Angrisani, S. Del Prete, E. Tagliatela

AORN Hospital of Caserta (Caserta-IT)

Higher energy trauma determines lower limb fractures. We talk about our clinical experience in the surgical therapy of these important and dramatic lesions which are important for patient's survival and compromise the bone segment, muscles and soft tissues involved in trauma. Confronting with this pathology needs the surgical experience of many specialists and the choice of timing and devices more useful to reach goals considering advantages and disadvantages of the technique and difficulties of everyone lesion. Thanks to choice protocols always used by the most of the Authors and according to criteria of emergency presented in every situation it is possible to show the limits of a device and to analyze the necessity of a new surgery to complete the first surgical act. So in our experience we relate about the possibility to use external fixation in emergency or nailing by closed surgery to treat complex fractures associated with instable steady-state in multiple injuries patients and to solve difficult problems of the complicated trauma. These devices lead to a rapid resolution of difficulties for surviving, to immediate rehabilitation and a good nursing of these patients.

TROCHANTERIC FEMORAL FRACTURES: PRELIMINARY EXPERIENCE USING DHS-LCP PLATE WITH A SPIRAL BLADE

A. Aquino, D. Lazzara, R. Cervone, G. Caruso, F. Del Prete, A. Petrini

Ortopaedic and Traumatological Department, Nuovo S. Giovanni di Dio Hospital (Florence-IT)

Introduction The Dynamic Hip Screw (DHS) represent the golden standard for the treatment of stable, trochanteric fractures [1]. Recently Synthes (USA) introduced two modifications at the system. Regarding the plate: the combined holes were introduced (like for the Locking Compression Plating), regarding the cephalic screw: a spiral blade was proposed (like in the intramedullary nails, e.g. PFN). These news are very useful especially in patients with osteoporotic bone. In fact the proximal spiral blade offers more guaranties against cut-out [2] and the plate with combined holes (locking screws) against pull-out of the diaphyseal screws.

Material and Methods From June to September 2007 we applied 14 DHS-LCP/spiral blade systems in 14 patients (10 female and 4 males) aged 83.5 years (from 74 to 98 years). All the trochanteric fractures were classified according to the AO criteria [3]. No difference was noted about the operative periods and blood loss in comparison to the application of the traditional DHS. The hospital stay was an average of 8.4 days (6 to 12 days) and all the patients were discharged for a rehabilitation structure. We evaluated all the patients clinically and radiographically after one month and monthly until the healing was achieved, noting if and how they could walk and move their affected hip.

Results All the fractures healed without complications (none osteosynthesis failed) in a meaning time of 2.5 months, and all the patients regained their activity level in an average of 3 months, except one 98 old female patient who died after 2.5 months for a hearty failure.

Discussion From our very initial experience, we are very positively impressed by the stability of the osteosynthesis with DHS-LCP coupling with a proximal spiral blade, and by the very short period for an optimal, functional outcome in these, very old and osteoporotic patients.

References

1. Lorch DG, Geller DS, Nielson JH (2004) Osteoporotic pertrochanteric hip fractures: management and current controversies. Instr Course Lect 53:441–454
2. Sommers MB, Roth C, Hall H, Kam BCC, Ehmke LW, Krieg JC et al (2004) A laboratory model to evaluate cutout resistance of implants for pertrochanteric fracture fixation. J Orthop Trauma 18:361–368
3. Rüedi TP, Buckley RE, Moran CG (2007) AO Principles of fracture management (2nd edn). Thieme Ed

SURGICAL TREATMENT OF NON-ARTICULAR DISTAL TIBIA FRACTURES: OUR EXPERIENCE WITH ETNS (SINTHES), A NEW INTRAMEDULLARY TIBIAL NAILING

T. Nizegorodcew, F. Pezzillo, G. Maccauro, A. de Mattheis, G. Palmieri

Dipartimento di Scienze Ortopediche e Traumatologia, UCSC, Policlinico A. Gemelli (Rome-IT)

The treatment of distal tibia fractures remains controversial. A variety of treatment methods have been suggested for these injuries, including non-operative treatment, external fixation, intramedullary nailing and plate fixation. Treatment selection is influenced by the proximity of the fracture to the plafond, fracture displacement, comminution and injury to the soft-tissue envelope. Intramedullary nailing can be considered the “gold standard” for the treatment of tibial midshaft fractures, but this indication was expanded to include distal tibia fractures. Intramedullary nailing

allows atraumatic, closed stabilization while preserving the vascularity of the fracture site and integrity of the soft-tissue envelope. Intramedullary canal anatomy at this level prevents intimate contact between the nail and endosteum, however, and concerns have been raised regarding the biomechanical stability of fixation and risk of malunion. An English study done in 2007 with 65 patients conclude that two or more distal locking screws are essential for the stability and the healing of distal tibia fractures. Additional to the standard static and dynamic locking options, the ETNS has multi-directional locking options in the distal and proximal part of the nail. The ETNS has a 10° bent (8 plus 2) which eases nail insertion and extraction, and gives the nail a better anatomic position in the intramedullary canal.

From January 2006 to December 2007 we treated in our Department 15 distal tibia fractures using ETNS; no patient had any change in alignment between the immediate postoperative and the final radiographic evaluation. At the final radiographic evaluation no patient presented malunion or non-union; we conclude that ETNS multi-directional distal locking screws (to the maximum of 4 screws) allows stabilization of distal tibia fractures improving biomechanical stability and reducing the risk of malunion.

TECHNICAL TIPS IN MALLEOLAR FRACTURES: THE PREVENTION OF COMPLICATIONS

M. Berlusconi, F. Chiodini, I. Scarabello, L. Dimento, D. Marchettini, A. Koenig, A. Giardella

Unità Operativa di Traumatologia, Istituto Clinico Humanitas (Milan-IT)

From January 2005 to January 2008 we operated 164 patients with malleolar fractures. We encountered complications in the 9% of these patients. These complications were: blisters, wound opening, infections, hardware subsidence, malunion and non-union. For each complication we found the aetiology and we studied the best technique in order to prevent them.

We conclude that the timing of surgery is the principal factor for the prevention of damage to the soft tissues and to prevent infections. In fracture-dislocation we prefer to avoid the surgery in emergency but we suggest skeletal traction or spanning external fixator till the skin will show typical wrinkles which will permit the surgical incision. CT scan may differentiate malleolar fractures from pilon fractures and may show talar fractures. Reduction should always be anatomical. The fibular reconstruction is better made with an antigliding posterior plating. In osteoporotic bone we suggest LCP reconstruction plate.

OUTCOME AFTER CANNULATED SCREW FIXATION OF INTRACAPSULAR FEMORAL NECK FRACTURES

R. Matteotti, E. Grosso, R. Sisto, F. Mosetto, M. Dolfin, K. Zoccola, A. Biasibetti

Dipartimento Traumatologia e Fissazione Esterna, CTO (Turin-IT)

Introduction Femoral head-preserving treatment for femoral neck fractures with cancellous screws is a method widely performed. Treatment of intracapsular fracture varies according to the pattern of the fracture, patients' age, bone quality, and comorbidities.

Methods We evaluated the surgical outcome following cannulated screw fixation of femoral neck fractures in 70 patients (Garden type I to IV fractures). All patients were treated between may 2003 and may 2007 by the same surgical equipe. The mean age was 49.3

years (range 25–65 years). Mean follow-up was 39.8 months (range 6–54 months). Mean preoperative time was 49.2 hours (range 2–220, median 24). WOMAC questionnaire and clinical documentation was used to evaluate patients' outcome.

Results The mean pain, stiffness and physical functional score was respectively 75.9, 76.4 and 77.3 (best score: 100, worst score:

0). Eight patients undergone femoral head necrosis, 2 patient had femoral neck collapse, 2 developed pseudoarthrosis.

Conclusions A significant correlation was found between WOMAC score, patients' age and comorbidity. There was no correlation between treatment outcome, follow-up time and preoperative time.

ORAL PRESENTATIONS

SPINE

SOMATIC STABILIZATION IN SEVERE SPONDYLOLISTHESIS

P. Bartolozzi, D. Pasquetto, M. Marino

Clinica Ortopedica e Traumatologica, Università degli Studi di Verona (Verona-IT)

Introduction A retrospective clinical study was conducted to evaluate the clinical and radiological outcomes of one-stage posterior decompression-stabilization after partial reduction and trans-sacral interbody fusion with a titanium cage for severe L5–S1 spondylolisthesis.

Methods Thirty-nine patients with severe L5–S1 spondylolisthesis were treated consecutively with posterior decompression, partial reduction, pedicular fixation, and posterior lumbar interbody fusion using a trans-sacral titanium cage. The mean age at the time of surgery was 25 years (range, 11–55 years). The mean follow-up period was 50.3 months (range, 12–125 months). Patients were evaluated for complications and fusions, and outcomes were collected using the modified Scoliosis Research Society Outcomes Instrument.

Results At follow-up, all patients, except one with major vascular complications, were extremely or reasonably satisfied with the surgery. All patients showed improvements in radiological indexes and stable fusion at the final follow-up examination.

Conclusions Posterior decompression and partial reduction followed by circumferential stabilization performed in one stage combining pedicle fixation with trans-sacral titanium cage interbody fusion is an effective and safe technique for the management of severe spondylolisthesis.

Suggested readings

1. Marchetti PG, Bartolozzi P (1997) Classification of spondylolisthesis as a guideline for treatment. In: The Textbook of Spinal Surgery (Second edn). Bridwell KH and DeWald PL (eds), Lippincott - Raven Publ., Philadelphia, pp 1211–1254
2. Bartolozzi P, Sandri A, Cassini M, Ricci M (2003) One-stage posterior decompression-stabilization and trans-sacral interbody fusion after partial reduction for severe L5–S1 spondylolisthesis. *Spine* 28:1135–1141
3. Lenke LG, Bridwell KH, Bullis D, Betz RR, Baldus C, Schoenecker PL (1992) Results of in situ fusion for isthmic spondylolisthesis. *J Spinal Disord* 5:433–442

STATE OF THE ART OF STUDIES ON GENETIC ORIGIN OF SCOLIOSIS: IMPORTANCE OF “CILENTO GENETIC ISOLATE”

C. Ruosi¹, M.G. Lettera¹, G. Persico^{2†}, M. Cipullo²

¹Orthopaedic Department, Faculty of Medicine, “Federico II” University (Naples-IT); ²Institute of Genetics and Biophysics “A. Buzzati-Traverso”, CNR (Naples-IT)

Objective Adolescent idiopathic scoliosis is known to aggregate within families, however, the pattern of inherited susceptibility is

unclear. A genomic screen and statistical linkage analysis of a genetic isolate, where individuals having idiopathic scoliosis are present, is performing to identifying variants responsible for this disease.

Summary of Background Data Scoliosis does not demonstrate a pattern characteristic of classical genetic (inherited) disorders. The severity of the disease within families can change and sometimes generations are skipped. However the role of hereditary or genetic factors in the development of this condition is widely accepted. Numerous investigators are currently attempting to locate these genes. Studies based on a wide variety of populations have suggested an autosomal dominant mode of inheritance or sex linked inheritance pattern. Other authors state that the “genetics link” may be complex, with an interaction of several genes, rather than just one. To identify chromosomal loci encoding genes involved in susceptibility to idiopathic scoliosis and the transmission way of scoliosis we are studying a Genetic Isolate.

Material and Methods We have generated a 10,600 individual complete pedigree of the village of Campora, in the Cilento area in Campania Region, starting from the beginning of the 17th century connecting all the 1200 living inhabitants. The actual population of Campora derives from few founders, therefore, the living inhabitants are all related each other. The population will undergo to clinical and radiographic evaluation for the presence and degree of scoliosis. A genomic screen and statistical linkage analysis of the families with individual having idiopathic scoliosis has been performed from 2004 until now and it will continue for the next three years.

Conclusions With this approach, considered the gold standard in the studies about the genetic origin of pathologies, we’ll be able to identify variants responsible of this complex disease and scoliosis genetics link’s.

Suggested readings

1. Alden KJ, Marosy B, Nzegwu N, Justice CM, Wilson AF, Miller NH (2006) Idiopathic scoliosis: identification of candidate regions on chromosome 19p13. *Spine* 31(16):1815–1819
2. Bashiardes S, Veile R, Allen M, Wise CA, Dobbs M, Morcuende JA, Szappanos L, Herring JA, Bowcock AM, Lovett M. SNTG1 (2004) The gene encoding gamma1-syntrophin: a candidate gene for idiopathic scoliosis. *Hum Genet* 115(1):81–89
3. Justice CM, Miller NH, Marosy B, Zhang J, Wilson AF (2003) Familial idiopathic scoliosis: evidence of an X-linked susceptibility locus. *Spine* 28(6):589–94

NEUROMUSCULAR SCOLIOSIS

F. Turturro

Orthopaedic Unit, S. Andrea Hospital, Second School of Medicine, University of Rome “La Sapienza” (Rome-IT)

A wide variety of neuromuscular diseases (NMD) affects children, including upper motor neuron disorders such as cerebral palsy, Rett’s syndrome and spinal cord injury; lower motor neuron disorders such as spinal muscular atrophy; peripheral nerve disorders such as Charcot-Marie-Tooth disease; neuromuscular junction disorders such as congenital myasthenia gravis; and muscle fiber disorders such as Duchenne’s muscular dystrophy. Although the origins and clinical symptoms vary significantly, outcomes related to musculoskeletal complications are often shared. Any neurological or muscular disease associated with a deficiency of muscular

strength and trunk control, in growing children, could be complicated by a spine deformity. The prevalence of scoliosis in neuromuscular patients is higher than idiopathic scoliosis in normal population, varying between 30 and 100% based on underlying disorders. The pattern of neuromuscular scoliosis usually includes a single "C" shaped, thoraco-lumbar curve. This curve may involve the sacrum and cause pelvic obliquity of different severity including condition where the pelvis is pressed against the ribs on the side of the concavity. Progression of scoliosis in NMD generates loss of comfortable sitting position; back pain; pressure sores; difficulties in nursing care; worsening of the respiratory deficiency. However, a direct relation between the degree of spinal deviation and the severity of respiratory deterioration has not been directly established. Often the clinical appearance and management of neuromuscular scoliosis are complicated by hyperkyphosis or hyperlordosis, hip contracture or dislocation, pelvic imbalance, respiratory deficiency and cardiac disorders. Several data indicate that conservative treatment with braces or spinal supports is unable to control the progression of the scoliosis, while surgical treatment appears to be the only effective treatment [1, 2]. The rate of complications (such as deep infection, wound healing impairment, hardware failure, respiratory or cardiac involvement and exitus) in surgical treatment of neuromuscular scoliosis is higher than in idiopathic curves. The risk of complications can be reduced by careful preoperative assessment. Our experience includes 192 neuromuscular scoliosis surgically treated, using Luque's or hybrid instrumentation; transiliac pelvic fixation was performed in 125 patients and a postoperative support with a plaster cast or braces was not used in any patient [3]. Surgical treatment seems to be able to correct scoliosis and pelvic imbalance and to permit a comfortable sitting position. In our experience, surgical treatment seems to be possible and safe in most neuromuscular patients, providing that the timing is carefully chosen, the respiratory situation is not too compromised and there are no signs of cardiomyopathy.

References

1. Miller F (2007) Spinal deformity secondary to impaired neurologic control. *J Bone Joint Surg Am* 89:143–147
2. Merlini L, Granata C, Bonfiglioli S, Marini ML, Cervellati S, Savini R (1989) Scoliosis in spinal muscular atrophy: natural history and management. *Dev Med Child Neurol* 31:501–508
3. King AG, Thomas KA, Eiserloh HL 3rd, Mills TE, Pisciotto DN (2000) Analysis of the STIF technique for spino-pelvic fixation: clinical results in 19 patients with neuromuscular scoliosis. *J Pediatr Orthop* 20(5):667–676

MINIMALLY INVASIVE TREATMENT OF TRAUMATIC COMPRESSIVE VERTEBRAL FRACTURES (VCFs) WITH AGF

V.F. Paliotta¹, B. Magliozzi¹, A. Piccioli², P. Palombi², L. Alessandro¹

¹Department of Orthopaedics, S. Eugenio Hospital (Roma-IT);

²Department of Orthopaedics, CTO Hospital, ASL RMC (Roma-IT)

Objective AGF combined with cancellous chips allograft are used in the treatment of severe fractures needing shorter time for recovery and having better results. Authors present their experience in amyelic traumatic compressive vertebral fractures (VCFs) treated by means of spinal percutaneous transpedicular fusion with AGF and cancellous chips allograft.

Material and Methods 18 traumatic compression vertebral fractures at risk of kyphosis were treated by means of vertebroplasty with AGF, and cancellous chips allograft. Mean age was 32 years,

mean follow-up 46 months. Orotracheal intubation was needed only in case of upper thoracic vertebral fracture (6 patients). In lumbar and lower thoracic spine fractures peridural anaesthesia was preferred. Patients were ambulant just a few hours after operation and they were discharged on 2nd day with a cast for 30 days. In all cases X-ray and CT were performed on 45th day, 3rd and 6th month. In first treated cases X-ray was also carried on 1st, 2nd and 3rd year after surgery.

Results Fusion was early reached in all patients. Clinical outcome was favorable in all patients but two who complained persistent back pain. No major complication was observed. Average 2° loss correction was observed at 1 year follow-up, 3° loss at 3-year control.

Discussion and Conclusions In conclusion in selected cases percutaneous transpedicular fusion with AGF and bone cancellous chips seems to be an excellent method of treatment in amyelic traumatic VCFs.

References

1. Paliotta VF, Lillo M, Piccioli A (2005) Blood Stem Cells in Minimally Invasive Surgical Treatment of Traumatic Spinal Fractures: Preliminary Results *J Bone Joint Surg Br Proc* 87-B:194
2. Paliotta VF, Magliozzi B, Alessandro L (2005) Percutaneous Transpedicular Fusion with Bone Chips And AGF in the Treatment of Traumatic Thoraco-Lumbar Fractures in Adults. ESS Annual Meeting, Oporto (Portugal)
3. Paliotta VF, Magliozzi B, Alessandro L (2006) Percutaneous Transpedicular Fusion with AGF in the Treatment of Traumatic Vertebral Fractures. SRS European And Middle East Meeting, Istanbul May 25–27, 2006

KNEE

FOCAL RESURFACING PROSTHESIS FOR UNICOMPARTMENTAL KNEE DEGENERATIVE ARTHRITIS

M. Marcacci, F. Iacono, S. Zaffagnini, M. Lo Presti, A. Di Martino, D. Bruni, G. M. Marcheggiani Muccioli, G. Giordano

Laboratorio di Biomeccanica, IX Divisione di Ortopedia e Traumatologia, Istituto Ortopedico Rizzoli, (Bologna-IT)

Unicompartmental Knee Arthroplasty (UKA) is one of the treatment options for relatively young and active patients with unicompartmental femoro-tibial early arthritis or moderate osteonechrosis, without severe axial deviation and with normal joint stability.

We developed a new focal resurfacing prosthesis (Maior) [1], which can be implanted with a minimally invasive or arthroscopic technique and minimum bone sacrifice.

Many surgeons, in case of focal articular damage, prefer to wait and made a unique definitive surgical operation when the degenerative changes are more severe.

This new prosthesis is an uncemented focal resurfacing implant based on a biological integration, able to guarantee an optimal bone ingrowth. The fixation system involves an immediate mechanical press-fit, which is achieved by a self-locking stem system and a secondary fixation system by bone regrowth obtain by an osteoconductive material inside the stems. The aim of this innovative system is to stimulate a tissue regeneration mechanism by using hydroxyapatite with its osteoinductive and osteoconductive properties [2].

The first 34 implants (mean age 65 years, range 52–77) were evaluated at 1 year mean follow-up. The Hospital for Special Surgery (HSS) knee score was used to compare the pre- and post-operative results. The HSS score improved from a pre-operative mean of 52.4 (range 20–60) to 85 at the last follow-up.



Fig. 1

Conclusion This modern resurfacing prosthesis (MaioR) is a valid alternative for selected patients with unicompartmental tibio-femoral disease.

References

1. Marcacci M, Iacono F, Zaffagnini S, Nofrini L, Neri MP, Russo A, Slomczykowski M (2004) Minimally Invasive Unicompartmental Knee Arthroplasty in Varus Knee. *Techniques in Knee Surgery* 3(4):259–266
2. Takakuda K, Koyama Y, Matsumoto HN, Shirahama N, Akita K, Shoji D, Ogawa T et al (2007) Material design of bioabsorbable inorganic/organic composites for bone regeneration. *J Nanosci Nanotechnol* 7(3):738–741

CERAMIC TOTAL KNEE ARTHROPLASTY

F. Benazzo, S.M.P. Rossi

Clinica Ortopedica e Traumatologica, Università degli Studi di Pavia, Fondazione IRCCS Policlinico San Matteo (Pavia-IT)

Total knee arthroplasty (TKA) can be considered a reliable operation with good, long-lasting clinical results. It does, however, have a weak point: its polyethylene liner, whose wear triggers the well-known cascade of bone resorption with debonding of the metallic components, leading to the failure of the implant. During the years, different materials, such as cross-linked polyethylenes, have been introduced to total joint replacement implants for both the hip and the knee in an attempt to sort out this problem, but more time and studies are needed to demonstrate the efficacy of these improved materials in terms of wear. Different sterilisation processes have decreased the oxidation of the plastic material and have shown their efficacy in reducing wear through decreased delamination, but are not able to positively influence adhesive and abrasive wear caused by the metal surface of the femoral component. Studies on retrieved femoral components have shown their surfaces to be more abrasive and ridged, which over time can increase the wear of the liner. Finally, allergy to the metal ions released by the metallic component of cobalt–chromium–molybdenum (CoCrMo) implants is an emerging issue, although its clinical relevance is still uncertain. As a result, current research is focusing on new materials and in particular on ceramic,

whose resistance to abrasion and better wettability and lubrication are well-known, can play an important role in reducing wear – both adhesive and abrasive – and in increasing the lifetime of the component. Ceramic is, also, totally inert, and thus can avoid the potential problem of allergy to metal ions. In this paper we will provide an update on the issue of ceramic TKA

Suggested readings

1. Hallab N, Merritt K, Jacobs JJ (2001) Metal Sensitivity in Patients with Orthopaedic Implants. *J Bone Joint Surg Am* 83:428
2. Bal BS, Garino J, Ries M, Oonishi H (2007) Ceramic bearings in total knee arthroplasty. *J Knee Surg* 20(4):261–270
3. Minoda Y, Kobayashi A, Iwaki H, Miyaguchi M, Kadoya Y, Ohashi H, Takaoka K (2005) Polyethylene wear particle generation in vivo in an alumina medial pivot total knee prosthesis. *Biomaterials* 26(30):6034–6040

TOTAL KNEE REPLACEMENT WITH MOBILE KNEE PROSTHESIS

F. Conteduca, F. Massai, D. Luzon, R. Iorio

Università degli Studi di Roma “La Sapienza”, Ospedale S. Andrea (Rome-IT)

The history of mobile knee prosthesis started during the 75'. The purpose of the new shaped design was to avoid the clinical failure of the classical prosthesis used at that time in which the low congruency between femur and tibia showed a very important loosening of the component due to the wear of the polyethylene. Some of the most implanted model at that time remained practically unmodified since their birth date and actually they show a long term result of the implant and the surgical technique. The purpose of a mobile bearing knee prosthesis is to decrease the amount of polyethylene debris and to obtain a good range of motion and stability. It is experimentally demonstrated that a mobile bearing knee prosthesis produces a low wear debris amount of polyethylene compared to a fixed bearing models, and good clinical results are showed in several papers. At the same time it should be observed that it is possible to see many models of mobile knee prosthesis produced from different industries. Usually each model show different shape and congruency producing different wear debris amount and clinical results due to the stability of the components. Considering the medial-lateral stability, antero-posterior stability, and rotational stability it could be observed that all the models show a very reduced constrained stress in rotational movement but antero-posterior and medio-lateral constraint is different between each model. For this reason some shapes were put out of stock from some industries because they showed poor clinical results with an important rate of dislocation of the mobile polyethylene. On the other hand some designs are practically unmodified from many years and demonstrate good clinical and radiological results with a very long follow-up. To date total knee replacement with mobile knee prosthesis seem to be a valid alternative to obtain good long term results reducing stresses over the undersurface of the metal back allowing the possibility to use uncemented component. The use of a computer assisted surgery reduces both the aggressiveness of this major surgery, eliminating the drilling of a femoral hole and potentially and the blood loss during surgery and in the immediate postoperative period, allowing a better alignment of the lower limb.

Suggested readings

1. Heim CS, Postak PD, Plaxton NA, Greenwald AS Classification of mobile-bearing knee designs: mobility and constraint. Orthopaedic Research Laboratories, Lutheran Hospital, Cleveland Clinic Health System

2. Buechel FF Sr (2002) Long-term follow-up after mobile-bearing total knee replacement. *Clin Orthop Relat Res* 404:40–50

BIOMECHANICS OF GUIDED MOTION TOTAL KNEE ARTHROPLASTY

F. Catani A. Ensini, C. Belvedere, A. Leardini, M.G. Benedetti, A. Feliciangeli, S. Giannini

Orthopaedic Surgery Department, Istituto Ortopedico Rizzoli, Motion Analysis Laboratory (Bologna-IT)

Introduction In the normal knee, the femur rolls posteriorly and rotates externally during flexion. Knee simulation studies have indicated that guided motion (GM) total knee arthroplasty (TKA) which enables for controlled rotation and rollback during flexion may permit more physiological motion after TKA. The purpose of this study was to determine whether GM-TKA replicates normal knee kinematics and kinetics in vivo by using mono-planar video-fluoroscopy and standard gait analysis.

Methods Fifteen patients affected by primary OA were operated by a posterior stabilized rotationally unconstrained fixed bearing GM-TKA (Journey®, Smith&Nephew). All patients were assessed clinically/biomechanically at 1 year follow-up. Clinical assessment was quantified using the IKS score. Knee kinematics was assessed using shape recognizing lateral mono-planar video-fluoroscopy during chair-rising, stair-climbing and step-up/down activities. Particularly, the contact-line rotation, defined as the rotation of the line connecting the medial and lateral tibio-femoral contact points with respect to medio-lateral axis on the tibial transverse plane, was measured. The antero-posterior translation of these contact points on the same plane during knee flexion was also calculated. Standard gait analysis for the same locomotor tasks was performed using an 8-cameras Vicon® motion system quantifying lower limb kinematics, kinetics, and electromyography.

Results A consistent medial pivoting pattern was observed in all motor tasks. Particularly, the average contact-line rotation during chair-rising, stair-climbing and step-up/down activities were respectively $13.0^\circ \pm 5.2^\circ$ (range: 8.7° – 21.7°), $10.5^\circ \pm 2.8^\circ$ (range: 6.4° – 14.0°), and $15.9^\circ \pm 5.2^\circ$ (range: 9.7° – 22.2°). In these motor tasks, the mean antero-posterior translation was respectively 7.4 ± 2.7 , 8.6 ± 3.5 , 4.2 ± 2.9 mm on the medial compartment, and 15.9 ± 2.6 , 16.7 ± 4.0 , 17.0 ± 4.5 mm on the lateral compartment. Gait analysis demonstrated in all patient symmetric kinematics and kinetics patterns. Knee joint rotations and frontal plane knee moment were close to normal. Two different sagittal knee moment patterns were found: a normal extension and flexion moment pattern associated with normal quadriceps and hamstring muscle activity (80% of the patients) and a permanent flexion knee moment associated with mild co-contraction of the quadriceps and hamstrings.

Discussion and Conclusions Our findings indicate that TKA design influences considerably knee kinematics. Our results also suggest that design features which enhance femoral external rotation and roll back during flexion such as an asymmetric cam post mechanism and anatomical shaped tibial plateaus are associated with a relatively normal pattern of motion after GM-TKA. Recovery of normal muscle activity of extensor and flexor muscle groups at the knee is likely accounted for the restoration of more physiological knee.

PATELLO-FEMORAL EVALUATION AFTER TOTAL KNEE ARTHROPLASTY: VALIDATION OF A NEW WEIGHT-BEARING AXIAL RADIOGRAPHIC VIEW

A. Baldini¹, J.A. Anderson², P. Cerulli-Mariani³, J. Kalyvas², H. Pavlov², T.P. Sculco²

¹Santa Chiara Clinic (Florence-IT), e-mail: drbaldiniandrea@yahoo.it; ²Hospital for Special Surgery (New York-USA); ³Ospedale Civile (L'Aquila-IT)

Background Radiographic assessment of the patella after total knee arthroplasty is typically performed with use of static, unloaded views that may not reproduce the in vivo patello-femoral kinematics. The purpose of the present study was to evaluate and validate the reliability and reproducibility of a weight-bearing radiographic assessment of the patello-femoral joint in patients who have undergone total knee arthroplasty.

Methods Radiographs were made for 100 knees in sixty-nine patients who had undergone total knee arthroplasty. Radiographic assessment of the patellofemoral joint was performed with use of both the standard Merchant axial view and a modification of that view. The Merchant axial view was modified by positioning the standing patient in the semi-squatted position with the knees in 45° of flexion. The relationship between the X-ray source, the angle of incidence on the joint, and the cassette position was kept unchanged from the original view. The standing position and consequent muscle involvement were the only differences.

Results Compared with the standard Merchant axial view, the weight-bearing axial view showed a number of patello-femoral tracking changes. Specifically, lateral tilt and subluxation of the patella were significantly reduced; the rate of exposed, uncovered patellar bone contact with the femoral trochlea was significantly increased; and radiographic evidence of maltracking was more closely correlated with clinical symptoms.

Conclusions An axial weight-bearing radiographic view with the patient in the semi-squatting position was developed to reproduce patello-femoral joint loading. This view demonstrates that the position of the patella, as seen on the standard unloaded Merchant view, changes during squatting. Utilization of this axial weight-bearing view to evaluate total knee arthroplasty may provide additional information over standard radiographic views.

LESS INVASIVE TOTAL KNEE ARTHROPLASTY: EXTRA-MEDULLARY FEMORAL REFERENCE WITHOUT COMPUTER NAVIGATION

P. Adravanti, A. Ampollini, F. Morici, S. Nicoletti

Casa di Cura Città di Parma (Parma-IT)

Objective Femoral intramedullary canal referencing is utilized by most of the total knee arthroplasty (TKA) systems. Violation of the canal is performed in order to engage rod instruments in the femoral diaphysis and to refer of the anatomical axis of the femur. Fat embolism, activation of the coagulation cascade, and bleeding may occur from the reamed femoral canal [1]. The purpose of our study was to validate a new set of “minimally-invasive friendly” instruments which allow to prepare the femur without violating the intramedullary canal.

Material and Methods Fifty consecutive patients undergoing primary TKA through a limited-parapatellar approach were enrolled in the study after informed consent had been obtained. Results of this cohort (group 1) were compared to another contemporary group (group 2) of 50 TKAs operated by the two authors using intramedullary instruments. The two groups were matched for gender, deformity, degree of arthritis, and surgical approach. Reliability of the new extramedullary set of instruments was first tested in ten cadaveric limbs. Preoperative long weight-bearing AP and lateral view of the knee were obtained taking care of neutral limb positioning. Templates of the mechanical and anatomical axis were performed. Distal femoral resection was planned according to the template, and considering a bone cut perpendicular to the

mechanical axis of the femur. Measurements from the template were reproduced on the distal femoral cutting jig. Flexion-extension control of the distal femoral resection was obtained using the anterior meta-diaphyseal cortex reference. Depth of resection, and varus-valgus angles were selected according to the previous measurements and referring over the most prominent distal femoral condyle. A double check was performed using an extramedullary rod referring two and a half finger-breaths medially to the antero-superior iliac spine. Postoperative blood loss, pain, swelling, functional recovery, and complications were recorded. Radiographic alignment was measured with full-limb X-ray.

Results Femoral component coronal alignment was within $0 \pm 2^\circ$ (a angle) of the mechanical axis in 84% of group 1 and 87% of group 2 ($p > 0.05$). Sagittal alignment of the femoral component was $0 \pm 2^\circ$ (g angle) in 88% of group 1 and 72% of group 2 ($p = 0.01$). There were no differences between the two groups regarding the operative time. In group 1, postoperative blood loss (740 vs. 820 ml) was reduced but this difference did not reach the statistical significance ($p = 0.07$). No difference was found in terms of post-operative pain, knee swelling, and functional recovery.

Discussion Extramedullary reference with careful preoperative templating can be safely utilized during total knee arthroplasty. Avoiding the violation of the femoral canal may enhance the benefits of a less invasive approach.

Reference

1. Kandel L, Vasili C, Kirsh G (2006) Extramedullary femoral alignment instrumentation reduces blood loss after uncemented total knee arthroplasty. *J Knee Surg* 19(4):256–258

TREATMENT OF INFECTIONS IN KNEE PROSTHETIC SURGERY

C.L. Romano¹, N. Logoluso¹, D. Romano¹, E. Meani²

¹Centro di Chirurgia Ricostruttiva e delle Infezioni Osteo-articolari (C.R.I.O.), I.R.C.C.S. Istituto Ortopedico Galeazzi (Milan-IT), e-mail: carloromano@grupposandonato.it; ²Centro delle Complicanze Ortopediche Settiche (C.O.S.), Istituto Ortopedico G. Pini (Milan-IT)

Infection after total knee arthroplasty may require different therapeutic solutions: one or two-stage revision, surgical debridement and suppressive antibiotic therapy, knee arthrodesis, amputation. The golden standard of chronically infected total knee prosthesis remains two-staged re-implantation, with infection eradication rates of more than 90%. Two-stage reimplantation with pre-formed, articulated, knee spacers offers predictable antibiotic release, allowing partial weight-bearing and range of motion and may be helpful to prevent joint stiffness and achieve better functional results.

We present the medium term results of a consecutive series of 36 patients (14 men and 22 women) treated with two-stage revision for chronically infected knee prostheses. All the patients underwent removal of the prosthesis and implant of a pre-formed antibiotic-loaded cement spacer (Spacer K, Tecres S.p.A.) and, after an interval period, to the implant of a modular knee revision prosthesis (PFC TC3, Johnson & Johnson-DePuy Inc.). Outcome assessment was based on the Hospital for Special Surgery score (HSS) and on patient responses to questionnaires for the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) and a satisfaction questionnaire.

At a minimum follow-up of two years (maximum 7 years), 4 patients are lost to follow-up, the infection eradication rate is 94.0% and no patient required revision for aseptic loosening. 32 patients were available for follow-up for functional, pain (Visual Analogue Score, V.A.S.), and satisfaction outcomes.

Pre-operative and post-operative HSS were respectively 44.1 ± 15.1 and 77.5 ± 14.1 ; range of motion: 71.2 ± 25.4 pre-operatively, 86.5 ± 18.7 post-operatively. Pain: 65 ± 18 pre-operatively, 21 ± 12 post-operatively.

Our results show, in a limited but homogeneous consecutive series of patients, that the use of a preformed articulated spacer and a modular revision prosthesis allow to achieve a high infection eradication rate, a significant increase in the joint range of motion and patient satisfaction. Costs and length of treatment appear as the main limit of two-stage revision surgery.

TUMOURS

MINI-INVASIVE BIOPTICAL TECHNIQUE IN SOFT TISSUE MASSES OF LIMBS

G.C. Gino¹, A. De Marchi², A. Linari³, C. Faletti², E.M. Brach del Prever⁴

¹S.C. Ortopedica Oncologica e Ricostruttiva, AO CTO/Maria Adelaide (Torino-IT); ²Dipartimento di Diagnostica per Immagini, AO CTO/Maria Adelaide (Torino-IT); ³Servizio di Anatomia Patologica A, Ospedale Infantile Regina Margherita-S. Anna (Torino-IT); ⁴Dipartimento di Traumatologia, Ortopedia e Medicina del Lavoro, Università degli Studi di Torino, Piedmont Sarcoma Group (Torino-IT)

Background Soft tissue sarcomas are malignant rare tumors; diagnosis is often delayed because of underestimation both of patients and physicians. In many cases, correct diagnosis is made on surgical specimens excised in multiple fragments and without any control of surgical margins (absence of “en bloc” excision, unknown margins). Histological diagnosis is difficult because multiple histotypes are possible. Preoperative diagnosis is mandatory in order to choose the correct treatment. Histotypes and grading on biopsy specimens could be underestimated or incomplete because of the difficulty to identify the correct area where focalize biopsy.

Aim To evaluate sensibility of US guided tru-cut biopsy focalised in areas with increased and/or anarchic vascularisation identified by EchocolorpowerDoppler with contrast medium, according to Piedmont Guides Lines on Soft Tissue Sarcomas (www.reteecologicapiemontese.it) implemented by Piedmont Sarcoma Group.

Material and Methods From January 2003 and March 2007, US guided biopsy after echocolorpowerDoppler examination without and with contrast medium (SonoVue®, Bracco) was performed in 186 patients with soft tissue masses at AO CTO/Maria Adelaide of Turin. 79 female, 109 male, age: range 18–94 years. Tru-cut (18–16 gauge, 15 cm length) US guided biopsy was performed in areas where number and patterns of vessel in real-time appeared more anarchic and/or with typical/atypical pattern. Correspondence of bioptical diagnosis (histotype and grading) with final diagnosis on surgical excised specimens, according to Regional Oncological Guide Lines, was evaluated. Patients studied by “old generation contrast medium”, used until December 2002, were excluded (results were published).

Results 170 diagnoses were correct; in 14 cases the final diagnosis was different. 90% of Sarcoma had numerous, irregular vessels with anarchic distribution; 90% of Lipoma masses presented few, regular, thin vessel; only some Mixofibrous Sarcoma had very rare vessels. Aggressive Fibromatosis had very numerous vessels in hypercellular areas and few vessels in fibrous zones. Angioma and Lymphangioma presented synusoidal regular vessels. One complication occurred.

Discussion Contrast medium in EchocolorpowerDoppler could improve the preoperative staging of soft tissue masses, identify-

ing areas and pattern of vascularisation. It allows studying the real flow through the vessels, whereas MRI and CT contrast enhancement occurs in interstitial spaces. Tru-cut US guided biopsy, focalised on areas where vascularisation is more representative, could be useful in choosing timing of biopsy and surgical therapy both in children and adults. Dynamic biological information on soft tissue masses could improve preoperative staging, differentiating benign and malignant lesions and focalising areas where performing biopsy.

OSSEUS METASTASIS ABLATION USING ELETROPORATION AND CHEMOTHERAPY

M. Fini¹, M. Alberghini², G. Bianchi³, M. Ronchetti⁴, M. Magni⁵, A. Dovesi⁵, M. Mercuri³, R. Cadossi⁴

¹Laboratorio Studi Preclinici Chirurgici, Istituto Ortopedico Rizzoli (Bologna-IT); ²Servizio di Anatomia ed Istologia Patologica, Istituto Ortopedico Rizzoli (Bologna-IT); ³V Divisione di Chirurgia Ortopedico-Traumatologica ad Indirizzo Oncologico, Istituto Ortopedico Rizzoli (Bologna-IT); ⁴IGEA Clinical Biophysics (Carpi-Modena-IT); ⁵Citiefre srl (Calderara di Reno-Bologna-IT)

Osseous metastases are a frequent complication of tumours: 1,100,000 cases of metastasis in bones per year in the EU. Such metastases are caused primarily by tumours of the breasts, prostate, lungs, kidneys and thyroid. At the time of clinical presentation 75% of patients present one or more of the following complications: pain, pathological fractures, medullar compression, hypercalcemia, reduction of movement and performance status. Pain is the most frequent symptom and is present in about one half of patients. Effective treatments of bone metastasis are not yet available. Electrochemotherapy (ECT) designates the use of short and intense electric pulses that transiently permeabilise the cell membrane (electroporation) with the aim of creating direct access to the cell cytosol for cytotoxic agents. The physical principles at the basis of the treatment (electric field distribution, amplitude and duration) allow precisely defining the tumour volume treated, while not affecting critical local structures such as blood vessels and nerves. ECT is employed in clinical practice and is effective in the treatment of cutaneous and subcutaneous lesions, however it has never been employed to treat bone metastasis. To be suitable for the treatment of bone metastasis ECT must completely ablate the lesion and also treat margins efficiently. Preclinical studies were conducted to determine the effects of the applied electric field on the cells interspersed within the trabeculae and the ability to effectively electroporate bone tissue. By strictly following Italian Laws on animal experiments, the distal femur condyles of rabbits were exposed and 4 stainless electrodes were inserted in a square configuration. A series of electric pulses was applied to all couples of electrodes. Increasing combination of voltages and number of pulses were tested to electroporate the target bone tissue. Tetracyclines were administered to determine mineral apposition rate as a functional measure of residual cell viability in the electroporated tissue. The animals well tolerated the treatment and returned to normal activity after the procedure. Seven and 30 days after treatment bone histology was performed on calcified and undecalcified sections. Tetracycline labeling showed lack of osteogenetic activity around and between the electrodes and the ablated area was dependent both on the number of pulses and the voltage applied. These findings confirm the safety of electroporation, demonstrate the feasibility of electroporation for bone tissues ablation and lay the foundation for the development of ECT in the treatment of bone metastases.

A NEW TREATMENT FOR UNICAMERAL BONE CYST

N. De Sanctis¹, A. Andreacchio²

¹Campolongo Hospital (Eboli-IT); ²Reparto di Ortopedia Pediatrica, Ospedale Infantile "Regina Margherita" (Torino-IT)

Objective Since Virchow first described the unicameral bone cyst (UBC) in 1876, several methods for management were proposed. Currently several surgical procedures are performed to treat this benign bone tumor. Elastic stable intramedullary nailing for the treatment of UBC in long bones has been rapidly gaining popularity. The goal of our study is to demonstrate that this method is safe, easy to perform and it's able to heal the lesion and our long term follow up support our conclusion [1].

Material and Methods Our study population consisted of 47 children: 36 boys and 11 girls between 4 and 13 years old (mean, 8.9 years) at the time of surgery. These patients were followed up for a



Fig. 1 Female, 12-year-old. UBC localized at her right femur. X-ray pelvis AP view (a) and axial view (b) at detection. X-ray AP view (c) and axial view (d) 1 month postoperative. X-ray 3 months postoperative (e), and X-ray at 4-year follow-up after removal of hardware (f). The UBC is graded as healed (Capanna et al., classification type I)

mean of 6.5 years (range, 2.4–11 years). The cyst was located in the humerus in 36 patients and in the femur in 11. No open or percutaneous biopsy was performed in previous nailing. We followed the classic surgical technique through retrograde nailing approach.

Results Results were evaluated on plain radiographs according to the classification system of Capanna et al. [2]. In our study population of 47 UBCs, 31 (65.9%) were classified as completely healed and 16 (34.1%) as healed with residual radiolucency. No recurrence or no response was observed. Each lesion responded to treatment after the nailing. Of the 47 UBCs, 31 (65.9%) healed within 36 months. Sixteen (34.1%) healed during a 36-month period, and they are the same UBCs which healed with residual radiolucency. No significant change in healing time was noted between the UBC nailed after a pathological fracture and without it [1].

Discussion Unicameral bone cyst is a benign fluid-filled lesion. Often a pathological fracture is associated with the diagnosis. The true etiology remains obscure. Several methods are still used to achieve consolidation of the cyst. Every technique is associated with complications and has an uncertain outcome. The results of the present study are in agreement with those in the Roposch et al. [3] study, in that flexible intramedullary nailing is an effective treatment of UBC. Our population is larger, and our follow-up is longer [1]. We do not have any recurrence on the basis of the retrospective analysis of the radiographs.

Conclusions This treatment has reduced the risk of pathological fracture. The parents should be aware that this method can avoid several anesthetics, which are mandatory when other methods are chosen. We feel that, with skilled hands, this method is the best UBC treatment in the long bones of the children.

References

1. de Sanctis N, Andreacchio A (2006) Elastic Stable Intramedullary Nailing Is the Best Treatment of Unicameral Bone Cysts of the Long Bones in Children? Prospective Long-term Follow-up Study. *J Pediatr Orthop* 26:520–525
2. Capanna R, Dal Monte A, Gitelis S et al (1982) The natural history of unicameral bone cyst after steroid injection. *Clin Orthop* 166:204–211
3. Roposch A, Saraph V, Linhart WE (2000) Flexible intramedullary nailing for the treatment of unicameral bone cyst in long bones. *J Bone Joint Surg* 82A:1447–1453

ENDOSCOPICALLY ASSISTED CURETTAGE OF BENIGN BONE TUMOURS: A NEW THERAPEUTIC OPTION

F. Sadile, F. Cigala, A. Lambiase, L. Maddaluno

Dipartimento di Ortopedia, Università “Federico II” (Naples-IT)

Introduction The endoscopy is first a medical diagnostic technique, mediated by direct vision, then developed considerably operatively, in orthopaedics, in the treatment of joint injuries. Following the technology implementation and the development of personal skill, each surgeon today can apply surgical treatment highly minimally invasive as in joint cavity as extra-articularly. The purpose of this paper is to present at a clinical and radiographic healing term 12 cases of semi-solid benign bone tumours treated with curettage endoscopically assisted.

Material and Methods From 1996 to 2006 we treated 12 selected cases: 4 affected by epiphyseal chondroblastoma (EC), 3 at proximal tibia and 1 at proximal humerus; 4 affected by osteoid osteoma (OO) of proximal femur (2) and tibia (2); 3 affected by non-ossifying fibroma (NOF) of distal femur (1) and distal tibia (2), in patients aged from 13 to 18 years; 1 child, of 3 years of age, was affected by Langherans cell disease of left ilium. In all cases surgical portals typically “arthroscopical” have been changed and managed in an extra-articular way.

Results EC and OO were evaluated at 18 to 9-year follow-up with very good results (75%). NOF were evaluated at a follow-up ranging from 5 to 3 years with complete reconstruction of bony district. Langherans cell disease was evaluated at a 4-year follow-up as very satisfying result with a complete reconstruction of bony ilium. No infections, no complications and no recurrence were encountered at time of writing.

Discussion The comparison with conventional surgical access, suggests that through a minimally invasive endoscopically assisted surgery it is possible to improve and accelerate the healing of some selected benign tumours; although some histotypes as non-ossifying fibroma are to be considered self-limiting and therefore with no need of surgical treatment, they still have an at-risk fracture and a rate of recurrence that would require, if necessary, a proper surgical treatment. In conclusion, with or without any need of biological or synthetic adjuvant, the results are highly rewarding for the orthopaedic surgeon and very promising for patients, including the purely aesthetic as well as functional point of view.

Suggested reading

1. Sadile F, Cigala F, Lambiase A, Maddaluno L, Cigala M (2006) Chirurgia mini-invasiva articolare ed extra-articolare assistita dall’endoscopia. Tecniche e risultati in patologia ortopedica. *Ann Ital Chir* 77:1–5

LOCAL ADJUVANTS IN THE TREATMENT OF MUSCULO-SKELETAL ONCOLOGIC DISORDERS

A. Piccioli, A. Ventura, F. Rodia, F. Gentilucci, M. Lillo, P. Palombi

II UOC Ortopedia e Traumatologia, Oncologia Ortopedica, CTO (Rome-IT)

The use of local adjuvants plays a major role in the treatment of metastatic lesions of the musculo-skeletal system, whose choice is mainly based on the surgeon personal experience. The principle of using local different matters is to furtherly expand the surgical curettage margin, eliminating any residual neoplastic cell, thus reducing, so far, the incidence of local disease relapse.

The first local adjuvant use in orthopaedic oncology was, at the beginning of the '70s, cryotherapy by liquid nitrogen as developed by Marcove at the Memorial Sloan-Kettering in New York City, N.Y., and PMMA acrylic cementation as described by Persson e Wouters.

Other techniques were developed during time, as chemical (phenol, ethanol and H₂O₂) and physical adjuvants (Argon gas thermocoagulation and cryotherapy by Cryoprobes).

It is important to stress that any chemical or physical agent cannot substitute a not correct curettage. As a matter of fact, surgical curettage has to be done aggressively, by using burr and aimed to remove any burring residual. Only following these guidelines it is possible to achieve the oncological success of the procedure.

ELUTION OF ANTIBLASTIC DRUGS FROM CEMENT IN THE TREATMENT OF SKELETAL METASTASIS

M.A. Rosa¹, G. Maccauro²

¹Università di Messina (Messina-IT); ²Università Cattolica Sacro Cuore (Rome-IT)

Aim PMMA is currently used as grouting agent of arthroprostheses and for filling of bone cavities after bone curettage. It is moreover used as a carrier of antibiotics in the local treatment of bone infections and it has been proposed as a carrier of antiblastic drugs in the

local treatment of bone metastases. The aim of this study is to analyse the biological properties and compressive strength of PMMA-Methotrexate mixture to be used for the local treatment of bone metastases.

Methods Cylinders of PMMA containing Methotrexate in different concentrations were manufactured according to ASTM F-451. Cylinders of PMMA were used as control. The porosity of the cylinders was characterised by SEM. Drug elution rate in saline solution was measured by HPLC. The biological activity of Methotrexate was analysed on human breast cancer cells using MTT test at different time (from 5 minutes to 30 days). Compressive tests were performed in conformity to ASTM F-451 on PMMA-Methotrexate samples and control as-made and after 30 days of aging in saline.

Results SEM analysis showed the presence of granules of Methotrexate on the surface of as-made cylinders that can be readily released from PMMA cylinders. The release occurred in large amount within 24 hours after immersion. We observed a relative release rate is more sustained in samples containing the drug in lower concentration. Also the biological activity was time dependent: cell death decreased progressively from 60% at 24 hours to 10% at 30 days. Compressive tests showed no statistical differences between PMMA cylinders containing Methotrexate and controls before and after aging in saline.

Conclusions The results show that PMMA-Methotrexate may be considered an interesting option in the treatment of bone metastases because cement allows mechanical resistance after bone curettage or resection and Methotrexate improves locally anticancer activity.

PROSTHETIC RECONSTRUCTION IN LIMB SALVAGE SURGERY OF THE LOWER LIMB: RESULTS OF A NEW MODULAR SYSTEM WITH POSSIBILITY OF CONVENTIONAL AND COMPOSITE PROSTHESES

R. Capanna, D.A. Campanacci, P. De Biase, G. Beltrami, G. Scoccianti

Orthopaedic Department, Division of Orthopaedic Oncology, AOU Careggi (Florence-IT)

Goals Prosthetic replacement of articular bone loss is a reliable reconstructive technique in limb salvage surgery. In 2001, a new modular prosthetic system was introduced for reconstruction of the lower limb by Waldemar Link. The system was designed to replace the proximal femur, the distal femur, the total femur and the proximal tibia and for intercalary reconstructions of the femur and arthrodesis of the knee. The same modular system allowed the assembling of an allograft as allograft-prosthesis composite in proximal femur and proximal tibia replacements. The authors review 190 consecutive cases of prosthetic reconstruction performed during the last five years with the new modular system.

Methods Between June 2001 and February 2007, 190 patients underwent prosthetic reconstruction of the lower limb with the new modular system. There were 98 males and 92 females with an average age of 48 years (11–90). The diagnosis was a primary malignant bone tumour in 78 cases, a bone metastasis in 70 cases, an aggressive benign bone tumor in 13 cases, plasmocytoma in 2 cases and lymphoma in 1 case. In 26 cases the prosthesis was implanted as revision of a failed periarticular osteosynthesis (15 cases) or of a failed prosthesis (11 cases). A proximal femur replacement was done in 100 cases, a distal femur in 63, a total femur in 12 and a proximal tibia in 6 cases. In 6 cases an extra-articular resection of the knee was performed and both the distal femur and the proximal tibia were replaced using an allograft-

prosthesis composite with the extensor mechanism of the allograft. In 3 cases the prosthesis was employed to achieve a knee arthrodesis.

Results Twenty-five major complications were observed in 21 patients. The most frequent complication was infection of the implant which occurred in 14 cases (7.3%). The mechanical failure of the Morse taper of the prosthetic body occurred in 6 cases (3.1%) requiring surgical revision and component replacement preserving the stem in place. Aseptic loosening was seen in 2 cases (1%) and prosthetic dislocation in 3 cases (1.5%). At final follow-up, 75% of the evaluable patients presented a satisfactory functional result following MSTS-ISOLS classification.

Conclusions The new modular prosthetic system for the lower limb may be successfully employed for prosthetic reconstruction or for allograft-prosthesis composite assembling. The preliminary data of the presented series of patients showed satisfactory functional results which need to be confirmed by a longer follow-up.

BASIC SCIENCE

RESEARCH ON THE LESIONS OF THE SPINAL CORD

G. Brunelli

European Spinal Cord Research Institute (Brescia-IT)

Objective Research (started in 1980) was done on rats and monkeys to show that muscles surgically disconnected from lower motoneurons and connected with the axons of the upper motoneurons responded to their stimuli.

Methods Apart from the research done on rats four groups of monkeys were operated on by connecting the cortico-spinal tract of the above the lesion cord with the motor nerves of gluteus maximus, gluteus medius and quadriceps with good results checked by E.M.G. and histology. After the permission of the Ethical Committee of the "Servizio Sanitario Nazionale", recently three human beings have been operated on with this surgical protocol. The first one who had undergone guillotine severance of the cord by dislocation of T8 is now able to walk with tripod sticks. Research on animals (rats) showed that the motor end-plates change their receptors from cholinergic into glutamatergic.

Results Functional reinnervation of the muscle was shown by E.M.G. and immunostaining. Genes codifying for receptors as well as the neurotransmitter were searched for. The administration of curare paralysed all the muscles but not the operated one, whereas GYKI (inhibitor for glutamate) paralysed the operated side. Immunoblot test showed that the operated muscle contains vesicular glutamate transporter-1 (VGLUT-1) whereas the control muscle still contains ChAT and VACHT. Furthermore this research demonstrated that the brain has a marvellous plasticity at the level not only of cortical areas but also of single neurons spread in different areas which fire simultaneously under voluntary command. What is more muscles receiving axons from neurons spread in the same various areas function selectively without co-contractions.

Conclusions The CNS-PNS connection is effective in both research and clinical surgery.

NERVE GAP RECONSTRUCTION BY MEANS OF MUSCLE-IN-VEIN CONDUITS

B. Battiston, L. Conforti, P. Tos

U.O. Microsurgery, Azienda Ospedaliera "C.T.O." (Turin-IT)

Various tubulization techniques can be used to bridge peripheral nerve lesions with substance loss. Among the different materials that have been used so far in alternative to traditional fresh nerve autografts, fresh muscle-vein combined conduits (made by a vein segment filled with fresh skeletal muscle) proved to be particularly effective (Battiston et al., Microsurgery, 2000). The first clinical applications were performed in our hospital on 1993. Since then we used muscle-in-vein tubes to fill gaps in sensory, motor and mixed nerves lesions. 45 cases were operated on with nerve gap ranging from 0.8 cm and 6 cm. The sensitive nerves which were repaired were 13, the mixed nerves 28 and the pure motor nerves 4. The mean follow-up was 24 months. All the patients were evaluated by means of the BRMC criteria and classified with Sakellarides method. In the sensory nerves we had 11 good or very good results. In the motor nerves 3 good results were obtained. As concerning mixed nerves, sometimes we had motor recovery not according with the sensory recovery: in 13 cases the result was good or very good for both motor and sensory recovery; in 6 cases we had good sensory recovery and a poor motor result; in 2 cases the prevalent recovery was the motor one. These results provide further evidence of the effectiveness of fresh muscle-vein combined grafts and support the view that this type of conduit can be used also for repairing long nerve gaps.

HEALING OF LARGE BONE DEFECTS TREATED WITH CANCELLOUS BONE ALLOGRAFT AUGMENTED BY AUTOLOGOUS BONE MARROW AND PLATELET DERIVED GROWTH FACTOR

P. De Biase, R. Capanna, R. Saccardi, I. Mancini, D.A. Campanacci

Orthopaedic Department, Division of Orthopaedic Oncology, AOU Careggi (Florence-IT)

Reconstruction of large bone defects is a major goal in orthopaedic surgery. Autologous cancellous bone is recognized as the most biologically active graft material, but autologous bone harvest is associated with significant morbidity and founds its limit in the available quantity. Biomaterials or allografts do not encounter these limitations, but have no osteogenic and limited osteoinductive potential. In order to enhance tissue regeneration and healing we have tried to obtain a graft with osteoconductive, inductive and osteogenic properties using mesenchymal stem cells and autologous growth factors obtained from peripheral blood. The day before operation 350 cc of autologous blood is donated from the patient and centrifuged to obtain platelet-rich plasma. Bone marrow is aspirated from the posterior iliac crests with the patient under spinal anaesthesia and is processed to increase its stem cell content. The graft used is fresh frozen cancellous bone provided from our Bone Bank. At operation the bone chips are mixed with the bone marrow buffy coat and platelet-rich plasma in a sterile glass becker. We have used this technique from November 2000 till February 2006 for 82 patients with large bone defects: 42 of these patients required healing of large bone defects: 23 males and 19 females. Fresh bone marrow alone was used for a percutaneous injection in 14 cases; open surgery with autologous growth factors, bone marrow buffy coat and allograft was used in 28 patients. In the other 40 cases 37 required surgery for long bone pseudoarthrosis and 3 patients for osteonecrosis of the femoral epiphysis. The radiological and clinical results showed early healing of the large bone defects treated with this technique and no complications related to the procedure.

TRABECULAR TITANIUM™

P. Dalla Pria, M. Pressacco, E. Veronesi

Lima-Lto (San Daniele del Friuli-Udine-IT)

Trabecular *Titanium*™ is an innovative multi-planar hexagonal cell structure imitating the structure of the trabecular bone. The morphology and dimension have been optimised to improve vascularisation therefore maximising osteointegration.

Trabecular *Titanium*™ elastic modulus (1.1 GPa) is very similar to the average value (0.7 GPa) of trabecular bone elastic modulus and the low rigidity of the Trabecular *Titanium*™ structure fosters the transmission of physiological loads from implant to bone. Compared to trabecular bone it is far more resistant, consequently it is the ideal filler/support structure for bone ingrowth.

The manufacturing technology of Trabecular *Titanium*™ allows producing both CP Titanium and Titanium alloy devices without coatings, forming a porosity-controlled implant. In fact, there is no separation between the bulk and the surface of the device, thus allowing avoiding any coating issues such as: detachment risks, surface rupture, and stress corrosion cracking.

Implant tests demonstrated high osteointegration and interesting BIC (Bone Implant Contact) values. Histological analysis showed large areas of periprosthetic lamellar cortical bone formation. Those areas totally surround the implant and the new tissue is strictly bonded with Trabecular *Titanium*™ without discontinuity or the presence of fibrous tissue.

The main features of Trabecular *Titanium*™ are: high friction with bone tissue, a prompt and successful osteointegration, good mechanical properties and the possibility to manufacture free form devices.

Trabecular *Titanium*™ can be applied in the most varied prosthetic components, e.g. primary and revision acetabular cups, stems and glenoid metal-backs. Trabecular *Titanium*™ can be also applied for custom made devices, since it allows obtaining, in a short time, implants in every possible shape.

THE HYALURONIC DISCOVERY

G. Tajana¹, C. Ruosi²

¹Hystology and Embriology, Faculty of Medicine, University of Salerno (Salerno-IT); ²Orthopaedic Department, Faculty of Medicine, "Federico II" University (Naples-IT)

The first description of Glycosaminoglycans (GAGs) was by Muller in 1836, who isolated "chondrin", a sugar-related substance from cartilage that was later shown to contain a sulfo group by Morner (1889) and renamed "chondroitinsure". It was not until 1935 that Karl Meyer discovered hyaluronic acid, initiating the exploration of GAGs biochemistry and the identification of "GAG-family". Karl Meyer isolated a formerly unknown glycosaminoglycan from the vitreous humor of the bovine eye. It differed from any of the other previously discovered glycosaminoglycans in that it did not contain sulfur. With its distinctive structure, its function within the body was unique. It was named hyaluronan and further scientific study ensued. At the time of its discovery, the new compound took on two names: hyaluronan when referring to its endogenous synthesis (*in vivo*) and hyaluronic acid when discussing research conducted outside of the body – human or animal (*in vitro*). Today hyaluronan is commonly referred to as hyaluronic acid, regardless of the context in which it is spoken. Hyaluronic acid was first used commercially in 1942 when Endre Balazs applied for a patent to

use it as a substitute for egg white in bakery products. The discovery of Hyaluronic Acid was very unique. No other molecule had ever been discovered that has such unique properties to the human body. Balazs went on to become the leading expert on HA, and made the majority of discoveries concerning HA. The first method used to produce Hyaluronic Acid was to extract it from some Hyaluronic Acid riched tissues such as cockscombs, human umbilical cord, and animal eyes' vitreous body. In later time, Kendall and other people found that some streptococcus may yield Hyaluronic Acid. Streptococcus is a kind of bacilli which can only be seen by microscope and is invisible for people's eyes. Inspected by the microscope, the streptococcus has a ball-like body, with a normal form of many individuals of streptococcus combined together, so they got their name streptococcus. The membrane mainly consisted of Sodium Hyaluronic Acid circles the main body as a protection layer from hurts. Hyaluronic acid, in its natural state, weighs anywhere from 1.2 to 1.5 million daltons. Its weight lends itself to high viscosity and excellent lubrication within the body.

ORAL COMMUNICATIONS

SPINE 1

EFFECTS OF INTERSPINOUS PROCESS DECOMPRESSION WITH THE X-STOP DEVICE FOR THE TREATMENT OF LUMBAR SPINAL STENOSIS

F. Amato, N. Tanturri, F. Casella, M. Papalia, F. Falez

Santo Spirito in Sassia Hospital (Rome-IT)

X-Stop is a interspinous process decompression (IPD) device, designed to distract the posterior elements of the stenotic segment, that have shown to be superior to nonoperative therapy in patients with neurogenic intermittent claudication, with or without back pain, secondary to spinal stenosis.

We present 13-month mean follow-up data of 21 patients (9 males and 12 females) affected by lumbar canal stenosis and submitted to implantation of X-Stop device. Duration of symptoms ranged from 6 months to 6 years. The exclusion criteria were fixed motor deficit, cauda equina syndrome and spondylolisthesis greater than grade I at the affected level. Clinical (VAS pain score) and radiological examination were performed at one, six and twelve months post-operatively.

In two patients we performed an additional minimal laminectomy to the X-Stop implantation.

Seventeen patients were treated for stenosis at one level (12 to L4-L5 and 5 to L3-L4) and 4 patients for two-level stenosis (L3-L4 and L4-L5 or L4-L5 and L5-S1). At the final follow-up 15 patients (71%) showed almost complete remission of pain while in 4 patients (20%) we observed only partial alleviation of sintomatology. In two cases (9%) pre-operative symptoms were unchanged and in one of these patients we had to perform a new surgical procedure for hemy-laminectomy. No major complications related to the surgery have been observed.

Our results showed that the success rate (complete and partial improvement) of the interspinous process decompression with X-Stop, is 91% at an average of 13 months postoperatively. Besides the X-Stop implantation increased partially the linear surface of foramen and minimally the AP diameter of the canal. This procedure resulted simple and safe, able to early resolve the symptoms in this patient's population. Long-term results are mandatory to assess reliability of this device and document its persistent effectiveness.

THE TOPS™ SYSTEM – A TOTAL POSTERIOR ARTHROPLASTY SYSTEM: DESIGN RATIONAL, BIOMECHANICAL CHARACTERISTICS AND INITIAL CLINICAL RESULTS OF IMPLANTATION

Y. Floman¹, R. Sinigaglia², Y. Anekstein², Y. Smorgick², Y. Mirovsky²

¹Tel Aviv-IL; ²Padova-IT

The TOPS™ system is a pedicle screw based family of implants that occupies the space of the posterior elements. It is a total posterior arthroplasty device. It is comprised of two titanium endplates, a polyurethane (PcU) boot that contains metal and PcU components that provide both mechanical stability and motion preservation. The TOPS™ system was developed as an alternative to fusion surgery in cases of moderate to severe spinal stenosis with facet arthritis.

It is intended to enable for complete surgical decompression and to reestablish stability with preservation of near normal physiological

range of motion. The metal on polyurethane articulation cushions against hard stops. The stoppers within the device maintain flexion extension, lateral bending and axial rotation. The design blocks sagittal translation that results from anterior shear forces and therefore it is possible to use the system in patients with degenerative spondylolisthesis. The double horizontal cross bar concept that anchors to the pedicle screws, connects two pedicle screws of the same vertebra. It minimizes screw loading and the risk of screw loosening and is different from the vertical screw rod design that connects two different vertebrae in other systems. The moment on the screw heads is thus reduced by 36–46% in flexion extension and lateral bending.

The design of the system not only provides near normal physiological range of motion but protects adjacent levels, optimizes screw-bone interface, minimizes and controls wear debris and outlasts the life of the patient. The device not only replaces the facets but also the soft and bony tissues removed during the decompressive procedure. The device supports the posterior axial loads, serves as a replacement of the supra and interspinous ligaments, controls motion in a similar fashion to the facet joints, imitates the facet capsule and the saline that fills the device imitates the synovial fluid. The cushioning of the polyurethane dampens the end points of these limits. The TOPS does not increase motion or intradiscal pressure at adjacent levels. The screws are blasted with carbon phosphate particles that provide for better bony integration. Static and dynamic tests that were performed exceeded the requirements of the FDA.

An initial clinical trial was held in Brazil, Turkey, Belgium and Israel and included 45 patients with spinal stenosis and/or degenerative spondylolisthesis of which 10 completed a 2 year follow-up after implantation of the TOPS device. Following adequate decompression the TOPS was implanted in either the L3–4 or L4–5 level. Patients were followed by radiography, Oswestry Disability Index (ODI) and VAS for back and leg pain. A significant reduction in back and leg pain was noted with significant improvement in function. The mean preoperative ODI dropped from 56 to 27.6 at 6 weeks and 16.7 at 2 years after surgery. The mean VAS dropped from 8.3 to 1.9 at 6 weeks and 2.0 at 2 years. Segmental and global motion was well maintained. Independent radiological analysis confirmed no evidence for screw loosening or device related malfunction. There was no evidence of change in disc height or progression of spondylolisthesis. Currently a multicenter study is conducted in the US with the monosegmental design and hybrid constructs that enables fusion at one level and motion preservation at the other level are clinically tested.

OUTCOMES OF DIFFERING SURGICAL APPROACHES ON DELAYED PRESENTATION OF ROTATIONAL LOWER CERVICAL INJURIES

F. De Iure¹, R. Donthineni², M. Cappuccio¹, S. Boriani¹

¹Divisione di Ortopedia e Traumatologia, Ospedale Maggiore (Bologna-IT); ²UC Davis Medical Center (Sacramento-USA)

Objective Delayed presentation of rotational lower cervical injuries (Argenson classification) present a difficult challenge for the management [1, 2]. Often the reduction appears satisfactory on the follow-up radiographs, but there may be still a slight misalignment and a slight clinical rotation of the neck but of cosmetic significance to the patient. We reviewed our various approaches to such injuries and evaluated the outcomes.

Material and Methods A retrospective review of our records revealed 13 patients with such injuries, with age range from 24 to 87 years; one at C 3/4, 2 at 4/5, 3 at 5/6 and 6 at 6/7 levels. The pre-

sentations were delayed at 3 to 35 weeks, and 5 had neurological symptoms. For reduction and fusion, the approaches were: anterior (A) in 3; anterior-posterior (A-P) in 4; posterior-anterior (P-A) in 3; and anterior-posterior-anterior (A-P-A) in 3.

Results For the radiographic incomplete reductions based on approaches: A 3/3; P-A 2/3; A-P 3/4; and A-P-A 0/3. The patients with incomplete reductions, although mild, had clinically visible slight rotations and were unhappy with the cosmetic appearance. Apart from one patient who died (A-P group), there were no other complications. Of the 5 with pre-operative neurological findings, 2 had improved but had residual symptoms. Only two patients had post-operative pain and were in the A and A-P group.

Discussion and Conclusions Although a small set of patients, we find that the A-P-A approach seems most appropriate for the reduction based on radiographic and clinical evaluations. The other approaches are inadequate for a satisfactory reduction.

References

1. Argenson C, Lovet J, Sanouiller JL, de Peretti F (1988) Traumatic rotatory displacement of the lower cervical spine. *Spine* 13:767–773
2. Sengupta DK (2005) Neglected spinal injuries. *Clin Orthop Relat Res* 431: 93–103

LUMBAR DISC REPLACEMENT: EFFECT ON SEGMENTAL AND LUMBAR SAGITTAL BALANCE AND MOTION

R. Sinigaglia, D.A. Fabris, Monterumici

Padova-IT

Introduction Total lumbar disc replacement (TLDR) is a motion-preserving alternative to lumbar spinal fusion for degenerative disc disease. Although in vitro cadaveric studies have provided invaluable information in preserving motion and possibly prevent abnormal loading at the adjacent level for TLDR, there is still lack evidence of in vivo consequences for sagittal balance and movement.

Purpose Aim of our prospective non-randomized clinical study was to analyze the consequences for segmental and sagittal balance and movement of TLDR.

Material and Methods From October 2001 through December 2006, 1-year minimum follow-up, 78 TLDR were implanted in 57 patients. 31 (54.4%) were female, 26 (45.6%) male. Mean age at surgery was 41.77 ± 7.46 years (30–57). 36 (63.2%) had single level TLDR, 15 (26.4%) 2-level, 3 (5.2%) 3-level, and 3 (5.2%) hybrid constructs. Replaced discs were L3–L4 in 5 (6.4%) cases, L4–L5 in 32 (41%), and L5–S1 in 41 (52.6%). AP, lateral, and flexion-extension periodical lumbar X-ray allowed to measure segmental lordosis, lumbar lordosis, segmental motion, and lumbar motion pre-, post-op, and at follow-up. Analyses were performed using 9.2 STATA statistical software, and 12.0 SPSS version. Differences were assessed using t or Mann-Whitney test. Samples of 3-level and hybrid constructs were too small for comparative analysis.

Results Mean follow-up was 35.02 ± 17.58 ms. Lumbar lordosis passed from $43.87^\circ \pm 11.82^\circ$ pre-op to $46.42^\circ \pm 10.83^\circ$ post-op ($p = 0.062379$), and $47.98^\circ \pm 11.97^\circ$ at last follow-up ($p = 0.008544$). L3–L4 segmental lordosis passed from $6.90^\circ \pm 3.51^\circ$ pre-op to $10.85^\circ \pm 5.22^\circ$ post-op ($p = 0.026971$), and $11.80^\circ \pm 2.59^\circ$ at last follow-up ($p = 0.064873$). L4–L5 segmental lordosis passed from $9.86^\circ \pm 5.06^\circ$ pre-op to $13.83^\circ \pm 6.21^\circ$ post-op ($p = 0.000611$), and $13.21^\circ \pm 6.11^\circ$ at last follow-up ($p = 0.000631$). L5–S1 segmental lordosis passed from $17.02^\circ \pm 5.32^\circ$ pre-op to $22.46^\circ \pm 6.27^\circ$ post-op ($p = 0.000001$), and $23.03^\circ \pm 6.81^\circ$ at last follow-up ($p = 0.000000$). Concerning movement, there was no differences between pre- and post-op L3–L4 ($p = 0.656045$), L4–L5 ($p = 0.458793$), or L5–S1 ($p = 0.157879$) ROM. Even lumbar motion

had no difference between pre- and post-op. There were no differences between single and double level replacement about lumbar and segmental lordosis, and about lumbar and segmental ROM.

Conclusions *In vivo* implanted TLDR affected sagittal balance, increasing segmental and lumbar lordosis. TLDR avoid spinal fusion maintaining normal motion, both segmental and lumbar. Single and double level disc arthroplasty have similar effects on balance and movement.

FENESTRATED PEDICLE SCREWS FOR CEMENT AUGMENTED PURCHASE

S. Terzi, S. Paderni, L. Amendola, F. De Salvo, S. Boriani

U.O. Ortopedia e Traumatologia, Ospedale Maggiore "C.A. Pizzardi" (Bologna-IT)

Pedicle screw fixation can bring about mobilization in case of poor bone quality [1]: osteoporotic elder, during revision surgery and in all the disease that compromise bone resistance: the bone-screw interface presents a small mechanical stability. It provokes the pull-out phenomenon. To face the problem different solutions are proposed in literature: larger diameter screw, longer bicortical screw, expanding screw, screw covered by HA, acrylic cement has been used to improve the fixation of pedicle screws in vertebrae [2, 3]. Since September 2006, in our division, we have been using fenestrated pedicle screws to allow direct injection in the vertebral body of PMMA. This surgical technique was used in 14 patients (6 man, 8 women): totally 54 fenestrate screws were applied, alone or with traditional ones, in: 3 osteoporotic fracture, 1 post-traumatic deformities with cauda compression, 4 precedent implant revision, 3 tumoral patients and 2 cases of degenerative disease. Complications came with the use of pedicle screws: 2 superficial infections healed with antibiotic therapy, deep venous thrombosis, cauda syndrome due to an early oral anticoagulant therapy treated by surgical decompression. In 3 cases we observed cement leakage from the vertebra into medullary canal and in one of this cases we found L2-L3 radicular palsy, partially improved in 6 month. During clinical pre-operative and follow-up evaluation all patients indicated the degree of pain with use of a visual analogical scale. The pre-operative score varied from 7 to 10 (mean 8.46), at the follow-up the score varied from 1 to 5 with medium decreasing of 5.4. No loosening phenomenon was found at X-ray evaluation. This is a promising technique useful for selected patients with a poor bone quality, anyway there are risks as neurological damage for cement leakage in the medullary canal.

References

1. Cook SD, Salkeld SL, Stanley T, Faciane A, Miller SD (2004) Biomechanical study of pedicle screw fixation in severely osteoporotic bone. *Spine J* 4(4):402–408
2. Polly DW, Orchowski JR, Ellenbogen RG (1998) Revision pedicle screws: bigger, longer shims – what is best? *Spine* 12:1374–1375
3. Frankel BM, Jones T, Wang C (2007) Segmental polymethylmethacrylate-augmented pedicle screw fixation in patients with bone softening caused by osteoporosis and metastatic tumor involvement: a clinical evaluation. *Neurosurgery* 61(3):531–538

SURGICAL TREATMENT OF SPONDYLODISCITIS

A. Gasbarrini¹, L. Boriani², M. Mazzetti¹, S. Terzi¹, L. Mirabile¹, M. Cappuccio¹, F. Franchi¹, C. Salvadori¹, G. Bakaloudis², S. Boriani¹

¹Ospedale Maggiore "C.A. Pizzardi" (Bologna-IT), e-mail: boriani.luca@gmail.com; ²Istituto Ortopedico Rizzoli (Bologna-IT)

Spondylodiscitis requires surgical treatment in a minimal percentage of cases, following precise indications and after a multi-disciplinary evaluation. The general principles for the management of spondylodiscitis consist of antibiotic therapy together with biomechanical immobilization of the spine segments involved.

Surgery finds its place in the treatment of selected vertebral infections. Debridement and stabilization must be performed in case of neurologic impairment, mechanical instability, progressive deformity, cervical lesion, abscess, failure of conservative treatment after 3 months of therapy. Target of the procedure is the debridement and the removal of the infected material from the involved spine level together with adequate and consistent stabilization.

Between 1997 and 2006, 129 patients affected by either pyogenic vertebral osteomyelitis or tuberculous spondylodiscitis were treated at Maggiore Hospital in Bologna. Forty-five patients were submitted to surgery (35%), with a total of 58 operations.

Preferred surgical approach was the posterior one (28 cases), sometimes through costo-transversectomy, in order to achieve a better deformity correction, obtain a good decompression and save pleura and abdomen cavity from the risk of contamination. According to the literature, the anterior approach is the best one. It allows a better and direct sight of the infected area, often localized in the anterior half of the vertebral body.

Surgical approach is surgeon-dependent and it is not relevant to the final result. Wide debridement and sound mechanical stability are required to achieve the resolution of the infective process. The subject of using metallic implants in the setting of infection remains controversial. After adequate debridement there is minimal risk for the instrumentation to help the growth of micro-organisms, above all in the setting of tuberculous infection.

MININVASIVE PERCUTANEOUS THORACOLUMBAR PEDICLE SCREWS FIXATION: A FOUR-YEAR FOLLOW-UP

L. Proietti, L. Oggiano, L. Scaramuzzo, R.F. Frasso, C.A. Logroscino

Department of Orthopaedic Science and Traumatology, Spine Surgery Division, Catholic University (Rome-IT)

Objective Minimally invasive spine surgery (MIS) has gained popularity in recent years. To date there are several MIS systems with the capability to perform pedicle screw and rod fixation. Only few of these, nevertheless, are able to perform multi-segmental pedicle screw and rod fixation. This study examines the advantages, the accuracy of screws' positioning and limits of one (Pathfinder) of these systems for the treatment of dorso-lumbar spine disorders.

Material and Methods From 2004 to 2008 by Spine Surgery Division of Department of Orthopaedic Science and Traumatology of Catholic University 50 patients 28 males and 22 females, with a mean age of 51.3 years (range 24–68 years) underwent the index procedure with or without neurological decompression to treat degenerative or traumatic pathologies of the spine. A maximum of 5 levels were fused with a single instrumentation in a single surgical procedure. All patients were evaluated post-operative with an antero-posterior and lateral X-ray at 1 m, 3 m, 6 m, 12 m and then every year, and with a CT of the treated levels to evaluate the screws' positioning. Clinical outcome was evaluated by SF-36 questionnaire and Oswestry Disability Index.

Results Mean surgical time was 142 min (80–180 min), mean time of percutaneous screws' positioning was 92 min (60–150 min) with a mean blood loss of 120 cc. Patients were discharged 6.6 days after procedure (range 3–15 days). There were no intra-operative or post-operative complications. Clinical outcome was very good in 37 patients, good in 8 and satisfactory in 5 patients. Screws' posi-

tioning was very good in 90.9% of cases, acceptable in 8.3%, and unacceptable in 0.75% according to the criteria published by Youkilis et al. [1].

Discussion The advantages of minimally invasive spine surgery are short surgical time, low blood loss, and minimal surgical complications with an equal accuracy in screws' positioning. The new wave of minimally invasive posterior spinal procedures is not a revolution but is, instead, an evolution of familiar, time-proven operative techniques. The traditional procedures often involve extensive muscular and bony dissection that can be associated with significant morbidity and prolonged recovery time. MIS techniques, instead, have been successfully used for different surgical approaches, such as discectomy, foraminotomy, fusion, and instrumentation for the treatment of a wide variety of pathological features, preserving the musculoligamentous complex and giving, so, to patients a faster complete independence in daily life activities.

Conclusions Our opinion is that the classical goals of open spinal surgery can now be allowed through much smaller corridors and with far less iatrogenic damage to the vital dorsal musculoligamentous complex.

Reference

1. Youkilis AS, Quint DJ, McGillicuddy JE, Papadopoulos SM (2001) Stereotactic navigation for placement of pedicle screws in the thoracic spine. *Neurosurgery* 48(4):771–778; discussion 778–779

ADVANTAGES OF OSTAPEK CAGES IN CERVICAL CORPECTOMY FOR CERVICAL SPONDYLOTIC MYELOPATHY

F. Ennas¹, M. Ganau², F. Oggiano¹, A. Gaviano², A. Maleci²

¹Department of Orthopaedics; ²Chair of Neurosurgery, University of Cagliari (Cagliari-IT)

Background Cervical Spondylotic Myelopathy (CSM) implies a degenerative condition of the cervical spine determined by direct compression of the spinal cord; progressive neurological deficits, or even uncontrollable pain should be considered as primary indications for surgical treatment. Myelopathy is generally determined by anterior epidural compression (osteophytic spurs, herniated disc, hypertrophy or ossification of posterior longitudinal ligament), hence posterior laminectomy or laminoplasty often does not solve the problem, while could be responsible for incomplete decompression, late deterioration and/or postsurgical deformity. Therefore anterior approaches, which allow for direct visualization and removal of ventral canal pathology, should be advocated as the first-line choice. Fusion techniques (with intersomatic or somatic cages) seem to be more useful than non fusion techniques for surgical treatment of CSM. Among the latest synthetic cages put on the market in the last years the Ostapek ones (made of 66.7% long fiber carbon composite and 33.3% PEKEKK resins) seems to provide an anisotropic elasticity closer to the biomechanical properties of the vertebral body and to guarantee the fastest bone fusion.

Material and Methods Between 2005 and 2007 a total of 38 patients affected by CSM have been admitted to the Neurosurgical Department at the University of Cagliari. A comprehensive clinical-radiological assessment revealed in each patient anterior spinal cord compression and myelopathy. Those patients underwent anterior cervical corpectomy and fusion using Ostapek cages filled with autologous bone obtained from corpectomy fragments. Only in one case (affected by rheumatoid arthritis) was necessary to perform an anterior plate fixation.

Results Mean duration of surgery was 2 hours, without need for hemotransfusion in any of the cases. Clinical outcome was

favourable in all patients but one, even if no structural problems, cord compression or pull out were ever radiologically observed. Plain and dynamic X-ray, spiral CT and MRI were performed in every patient at 3 and 6 months postoperatively: correct placement of the Ostapek devices and high degree of fusion were always detected.

Conclusions Our experience confirm that this surgical option allows for wide spinal cord decompression, direct stabilization of the cervical segment, limited surgical time, and rapid postoperative recovery. Finally Ostapek cages in cervical corpectomy seem to guarantee the rapid rate and high quality of bone fusion.

BALLON KYPHOPLASTY IN SOMATIC DORSOLUMBAR TRAUMATIC FRACTURES

G. Fargnoli¹, R. Speciale¹, G. D'Eletto¹, P. Mimmo¹, S. Fargnoli², A. Gallon³

¹UOC of Orthopedics and Traumatology "S. Scolastica", AUSL of Frosinone (Cassino, Frosinone-IT); ²Medicine Institute, University of Rome "Tor Vergata" (Rome-IT); ³Legal Medicine Institute, University of Rome "La Sapienza" (Rome-IT)

After extensive experience in the treatment of osteoporotic and osteolytic vertebral collapse with recent kyphoplasty with IAB and cement acrylic, we extended the indication of this treatment to somatic traumatic fractures composed and broken both stable unstable.

To date 36 cases were treated with one or more somatic fractures. The age of patients ranged from 28 to 55 years. We used, under local anaesthesia with light sedation, a technique for minimally invasive skin, which fit in fractured vertebral body a stem or two balloons parapeduncular expansion going to reduce the fracture and creating a space where cement fits (by low pressure) and in few minutes (3–4 min) solidifies stabilizing the fracture and producing pain relief. We used bone cement with calcium phosphate riassorbibile KyphOs FS. Twenty-four hours after surgery the patients resumed erected station and could walk with a bust fence in cloth that was removed after ten days, time at which 2 points suturing the skin were also removed. After one-year follow-up the patients' outcome is good. A longer follow-up is necessary to define the goodness of the technique: cement reabsorption and colonization with regenerated bone.

Suggested readings

1. Becker et al (2002) Minimally invasive kyphoplasty in osteoporotic and tumor patients. *EuroSpine* 9
2. Carlson et al (2002) Is there an increased risk of adjacent segment VCF after kyphoplasty? *AAOS*
3. Coumans et al (2002) A prospective study of kyphoplasty patients followed for a minimum of one year. *EuroSpine* 9
4. Dudeney et al (2002) Kyphoplasty in the treatment of osteolytic vertebral compression fractures as a result of multiple myeloma. *Journal of Clinical Oncology* 20(9):2382–2387
5. Fourney et al (2003) Percutaneous vertebroplasty and kyphoplasty for painful vertebral body fractures in cancer patients, *J Neurosurg (Spine)* 98:21–30
6. Garfin et al (2001) New technologies in spine: kyphoplasty and vertebroplasty for the treatment of painful osteoporotic compression fractures. *Spine* 26(2):1511–1515
7. Lane JM, Girardi FP, Khan SN, Parvataneni HK, Reiley MA, Leiberman IH et al. Preliminary outcome of the first 226 consecutive kyphoplasties for the fixation of painful osteoporotic vertebral compression fractures. *ISSLS 28th Annual Meeting. Abstract Book*, p 109
8. Ledlie et al (2003) Balloon kyphoplasty: one year outcomes in

- vertebral body height restoration, chronic pain, and activity levels. *J Neurosurg (Spine 1)* 98:36–42
9. Lieberman et al (2001) Initial outcome and efficacy of kyphoplasty in the treatment of osteoporotic VCFs. *Spine* 26(2):1631–1638
 10. Mitchell et al (2001) Clinical outcomes with kyphoplasty for osteoporotic VCFs. *NASS* 10
 11. Phillips et al (2002) An in vivo comparison of the potential for extravertebral cement leak after vertebroplasty and kyphoplasty. *Spine* 27(19):2173–2179
 12. Theodorou et al (2002) Percutaneous balloon kp for the correction of spinal deformity in painful VCFs. *J Clin Imaging* 26:1–5
 13. Wong et al (2000) Vertebroplasty / kyphoplasty. *J Women's Imaging* 2(3)

SPINE 2

VERTEBROPLASTY AND KYPHOPLASTY: COMPLICATIONS

N. Tanturri, F. Amato, F. Casella, M. Papalia, F. Falez

Santo Spirito in Sassia Hospital (Rome-IT)

Percutaneous vertebroplasty and kyphoplasty are surgical technique widely accepted for treating vertebral compression fracture, both traumatic and related to neoplastic lesions (primitive tumors or metastatic localizations). Despite of well-established clinical advantages, there is still a lack in peri-operative complications data. Aim of this study is to detect and analyze specific complications and related risks for each of these procedures.

We treated between September 2003 and February 2008 169 patients affected by vertebral compression fractures. Forty-seven patients (53 levels) received a vertebroplasty, while 122 (154 levels) were treated with kyphoplasty: a total of 207 procedures have been analyzed. Peri-operative adverse events were divided in 2 groups: Major Complications (clinically evident, requiring a specific treatment) and Minor Complications (non-symptomatic, with no influence on post-operative recovery).

We detected 5 Major Complications: 1 case of disco-somatic cement leakage, with central swelling nucleus dislocation and subsequent intra-foraminal herniation. Due to L3 root compression, a secondary procedure of laminar decompression and herniectomy has been necessary, with full recovery of symptoms. A subsequent adjacent level fracture occurred in 3 cases: 2 of them occurred near a level treated by kyphoplasty, the third after a vertebroplasty procedure. All of them received a secondary cemented augmentation technique (kyphoplasty). An unusual complication detected in our experience was a rib fracture, occurred in an 81-years old woman, and attributed to patient positioning.

The main Minor Complication observed was an asymptomatic cement leakage: we detected radiological sign of cement outflow in 36 cases treated with vertebroplasty (68%) and 14 cases receiving kyphoplasty (9%).

Cement leakage represents the only significant complication in our experience. Adjacent level fractures, in fact, occurred with an extremely low rate (3 cases in a 169 patient population), while the unusual rib fracture may be considered an occasional event, being not related to surgical technique but to patient positioning.

As confirmed by our experience, cement leakage is often asymptomatic: anterior and lateral outflow are usually clinically silent, while disco-somatic leakage may dislocate part of the disc, causing a neurological symptomatic compression. This last complication appears to be more frequent in vertebroplasty compared to kyphoplasty (respectively 68% and 9%). It may be attributed to peculiar

aspects of surgical technique: In vertebroplasty a low-viscosity cement directly injected in the vertebral body has to be used, while in balloon-assisted kyphoplasty an high-viscosity cement augmentation is performed in a neo-cavity (intra-somatic expansion, able to partially restore the vertebral height).

A large amount of data in literature affirms that both the techniques are able to reduce pain in vertebral compression fractures, with similar results. On our advice, however, kyphoplasty seems to be more versatile and safe, compared to vertebroplasty, even in massive osteolytic lesions observed in pathologic fractures. The main disadvantage of kyphoplasty remains the costs of instrumentation, considerably higher than vertebroplasty.

VERTEBROPLASTY: TECHNIQUES TO AVOID COMPLICATIONS. CLINICAL RESULTS

R. Scarponi, S. Scarponi

Department of Orthopaedic Surgery, Policlinico Santa Rita, (Milan-IT)

Objective The use of Vertebroplasty for treatment of spinal fractures is an uneasing procedure at rapide time, although it is a minimally invasive procedure, performed by local anesthesia. This technique is based on the injection of cement into a vertebral body, with a percutaneous approach. Same complications have been reported. The unintentional migration of cement (PMMA) in our patients was not a relevant event. All patients were treated by percutaneous Vertebroplasty, with accurate needle or trocar placement, through pedicle, under direct fluoroscopy visualization.

Material and Methods During a 4-year period, 220 levels of Vertebroplasty were performed on 146 patients presenting untractable pain resulting from vertebral body compression fractures. In these series, the 92% of patients underwent Uni-pedicular Technique. After pedicle definition corresponding to the waist, under fluoroscopy, trocar advanced trans-pedicular. Care was taken to avoid in the bone access trocar penetration of the endplate on the cortex; drill was never used. The cement was slowly injected until vertebral body was filled. MRI or CT scan confirmed vertebral collapses, bone oedema in more recent or new fractures.

Results 66% of patients showed multiple levels vertebral compression (one to six). The medical records of patients were reviewed for these factors: pain relief, functional restore, walking ability, no pharmacotherapy, no brace. The hospitalization lasted 24 hours. Vertebroplasty patients were followed-up at 3 weeks and 3 months by X-ray.

Discussion To prevent septic complications we always performed this procedure in operating room. The local anaesthesia is mandatory to prevent spinal cord injury. Success rate (pain-relief) was 89%. In previous literature pain-relief is not always observed. In our series, twenty-four hours after Vertebroplasty the patient had pain-relief, standing and walking without brace. We believe that pain-relief resulted since these patients were close to the individual limit of tolerable pain and the compression fractures were extremely painful. The 68% had an improvement in physical functioning, that remains unchanged to date. One patient had symptomatic pulmonary embolism. The antithrombotic profilaxis with anticoagulant drugs is recommended in this case. Five cases with cement migration had neuralgia without spinal cord damage and resolved after a 3-month rehabilitation.

Conclusions In our experience Vertebroplasty is a safe and effective procedure for treating acute osteoporotic vertebral compression fractures. In patients with osteoporosis and recurrent fractures the same procedure was repeated. One other option of this

procedure is the prevention of fractures. The research aiming at reducing fracture-healing time on bone fragility is leading to new potential treatments using cellular pathways: osteogenic cells and platelet-derived growth factors.

EXPRESSION OF NGF AND ITS RECEPTOR TRKA IN DEGENERATIVE LUMBAR FACET JOINTS SPECIMENS

M.F. Surace, D. Prestamburgo, M. Campagnolo, A. Fagetti

Department of Orthopaedic and Trauma Sciences "M. Boni",
Universitas Studiorum Insubriae (Varese-IT)

Introduction In a preliminary study the occurrence of nervous terminations was demonstrated with optical microscopy in several slides of degenerative lumbar facet joints and surrounding soft tissues. The aim of this study was to prove the presence of NGF and its receptor TrkA with immunofluorescence.

Material and Methods The peri/articular tissues were harvested from the lumbar facet joints of 10 patients surgically treated for degenerative diseases. There were 7 females (1 bilateral) and 2 males whose mean age at surgery was 72 years (range, 67-80 years). The affected levels were L3-L4 in 2 cases and L4-L5 in 7 cases (1 bilateral). All specimens were fixed in formalin, dehydrated and enclosed in paraffin. From each specimen 4 slides were obtained. Two slides were employed for the search of NGF, one was treated with specific antibodies and marked with FITC, the second slide was for control purposes and was exposed to FITC, but not the specific antibody. The same procedure was repeated to obtain two more slides in order to repeat the search for TrkA. All the slides were observed under a fluoromicroscope.

Results The analysis of these specimens revealed the presence of NGF and its own receptor TrkA in all cases: the immunohistochemical reaction between the specimens and the specific antibodies marked with FITC was seen under fluoromicroscopy, but in none of the control cases treated with FITC only.

Discussion NGF is released by mastocytes, fibroblasts and other cell types involved in the inflammatory processes. The levels of peripheral NGF are increased in inflammatory processes. There is considerable evidence that shows that the system constituted by the nerve growth factor (NGF) and by the high-affinity receptor TrkA plays a fundamental role in the molecular processes underlying the main forms of "persistent" pain. This indicates a possible therapeutic area for the antibodies that could block the NGF/TrkA system, in order to modulate the frequency and the duration of the action potential of nociceptive neurons during chronic inflammation. This study demonstrates the presence of NGF and TrkA in specimens collected from degenerative facet joints, suggesting that specific molecules could be used in order to modulate chronic pain in patients with degenerative lumbar spine.

MINI-INVASIVE TREATMENT OF MONOLEVEL LUMBAR CANAL STENOSIS: OUR EXPERIENCE

F. Ennas¹, M. Ganau², A. Gaviano², F. Oggiano¹, A. Maleci²

¹Department of Orthopaedics, ²Chair of Neurosurgery, University of Cagliari (Cagliari-IT)

Background The surgical treatment of lumbar stenosis has known a renewed impulse so far due to recently introduction of mini-invasive and/or percutaneous techniques of placement of interspinous devices. Biomechanical studies have shown that the use of interspinous prosthesis increases axial spinal canal and sagittal lateral

foramen areas; and decreases articular facets and discal anulus overloads. Moreover interspinous devices do not limit axial rotation or lateral flexion of the lumbar spine, nor influence the adjacent vertebral segments. These data justify the immediate postoperative improvement of symptoms and rapid recovery.

Material and Methods Between 2006 and 2008 a total of 42 patients affected by monolevel lumbar stenosis have been admitted to the Neurosurgical Department of the University of Cagliari (mean age 68 years, ratio M/F = 20/22). Each patient showed neurogenic claudicatio, and low back pain alleviated by rest or by the anterior flexion of the body. Neuroradiological examinations confirmed the diagnosis of lumbar stenosis, caused by bulging discs or ligaments hypertrophy, with reduction of sagittal lateral foramen area and interbody height. Those patients underwent to mini-invasive surgical treatment with interspinous X-Stop devices, placed in local anesthesia (30 cases at L4-L5, 9 at L3-L4, 1 at L5-S1, and 2 cases at adjacent levels L3-L4 and L4-L5).

Results Every patient showed complete resolution of low back pain (according to VAS), without any limitation of walking. In only six cases we have observed within few months from surgery (3 cases at 3 months, and 3 cases at 6 months) a worsening of symptoms. Clinical and radiological data from each case were reviewed allowing to detect the presence of a mono or multilevel microinstability requiring the removal of interspinous device and traditional laminectomy plus arrectomy and stabilization. Moreover we have noticed that excessive tension of interspinous ligament, determined by an oversized device can be responsible for hyperflexion segmental stress and worsening clinical outcome at follow-up.

Conclusions Our experience confirms the efficacy of X-Stop devices in the surgical treatment of selected patients affected by monolevel lumbar stenosis. This "non-fusion" stands alone surgical option, guarantees decompression of neural structures, with minimal amount of tissue damage, and respect of bony structures and sovraspino ligament. Indeed this technique allows extending the surgical indications to older patients, or whenever short surgical time, avoiding general anaesthesia and rapid postoperative return to daily life activities represent a clear clinical advantage.

CORRELATION BETWEEN HUMP DIMENSIONS AND CURVE SEVERITY IN IDIOPATHIC SCOLIOSIS BEFORE AND AFTER CONSERVATIVE TREATMENT

A.G. Aulisa¹, L. Aulisa², C. Perisano², G. Mastantuoni¹, V. Guzzanti³

¹Ospedale Pediatrico Bambino Gesù, IRCS (Rome-IT); ²Università Cattolica (Rome-IT); ³Cattedra di Ortopedia e Traumatologia, Università di Cassino (Cassino-IT)

Objective The purposes of our study are two: (1) verify a potential correlation between the hump dimensions and the scoliosis curve severity; (2) evaluate how the treatment can influence the main characteristic parameters.

Material and Methods 134 patients (13 males and 121 females) with an average age of 12.83 ± 1.93 years (ranging between 6 and 18 years) affected by adolescent idiopathic scoliosis have been treated with brace until the complete skeleton maturity (72 Lionese, 41 P.A.S.B., 4 Milwaukee; 13 mixed treatment P.A.S.B. + lionese, 3 Milwaukee + Lionese, 1 P.A.S.B. + Milwaukee). To evaluate the treatment progress two parameters were taken into account: the hump (clinically measured with humpmeter) and the Cobb angle (measured by X-ray of whole spine under load). Measurements have been taken at the beginning and the end of the treatment. Statistical analysis has been performed using non parametrical tests to compare averages and make linear regressions between parameters.

Same evaluations have been made later dividing the whole group in 4 sub-groups: patients with lumbar curves (66), thoracic curves (68), patients with age ranging between 14 and 18 (45) and between 6 and 13 (89).

Results Our data showed that a real correlation between hump and curve severity, in Cobb degree, exists (significativity was lower than 0.001 at the beginning and end of the treatment): higher curve severity corresponds to an higher hump dimension. Furthermore the effectiveness of the orthoses treatment to correct the curve severity and remodel the hump was highlighted. Treatment starts with a Cobb angle of 29.41 ± 8.53 and ends at 19.29 ± 9.84 . Hump begins with a value of $11.61 \text{ mm} \pm 5.59 \text{ mm}$ and finish at $6.19 \text{ mm} \pm 4.61 \text{ mm}$. It was also noticed that the hump correction is higher than the correction of the curve registered in Cobb degrees. In particular, this is more noticeable: (1) in thoracic curves: percentage average correction in Cobb degrees was -30.07 ± 25.31 while hump was -45.95 ± 38.02 ; Wilcoxon test shows that the differences are significant ($p = 0.01$); (2) in patients aging between 6 and 13: percentage average correction in Cobb degrees was -34.99 ± 27.68 while hump was -43.22 ± 45.29 ; Wilcoxon test shows that the differences are significant ($p = 0.019$).

Conclusions The hump is the effect of the rotation of the scoliosis curve. At thoracic level hump is averaged by ribs and, for this reason, there is a less important correlation with the increase of spine deformity. Orthoses treatment of idiopathic scoliosis fixes the spine deformity and, also, is very effective to remodel the hump. This phenomenon is more noticeable at backbone level where the main action is performed to the rib cage.

MINIMUM 25-YEAR RESULTS AND QUALITY OF LIFE AFTER LUMBAR DISCECTOMY

M. Mariconda, O. Galasso, V. Secondulfo, G. Della Rotonda, C. Milano

Dipartimento di Ortopedia, Università Federico II (Naples-IT)

The surgeon-oriented evaluation has been used traditionally to assess the long-term results of a discectomy for lumbar disc herniation, but in recent decades patient-based outcome instruments have gained increasing importance in this evaluation. A comprehensive patient-oriented evaluation should include measurements of disability along with a reliable evaluation of the general health status. There is few data from validated measuring instruments on the very long-term outcome of lumbar discectomy. A follow-up study was carried out to assess the minimum 25-year outcome of discectomy for lumbar disc herniation. We conducted a follow-up study of 201 patients on an average of 27.8 years after lumbar discectomy (range: 25–32 years). The patient-oriented assessment included: an SF-36 questionnaire, Oswestry Disability Index, Cumulative Illness Rating Scale, and a study-specific questionnaire dealing with daily life activities and satisfaction with the surgery. Factors significantly influencing the SF-36 summary scores and the ODI were also checked at multivariate regression analysis. The SF-36 physical scales and summary scores were similar to the normative values for healthy subjects and were better than the scores of patients with untreated sciatica with respect to reported pain. The mean Oswestry disability score was 17.5. Satisfaction with surgery was expressed by 181 of 201 patients (90%). The sudden postoperative relief from pain positively predicted most of the outcomes, whereas comorbidities were negative prognostic factors at the regression analysis. In conclusion, patients who had undergone lumbar discectomy a minimum of 25 years earlier have a satisfactory self-reported health-related quality of life and less pain than non-surgically treated subjects.

VESSEL-X® KYPHOPLASTY FOR TREATMENT OF THORACOLUMBAR SPINE FRAGILITY FRACTURES: TWO-YEAR FOLLOW-UP OF 110 CONSECUTIVE PATIENTS

R. Iundusi¹, G. Ferraro², G. Cannata¹, M. Portaluri², V. Tempesta¹, U. Tarantino¹

¹Orthopaedics and Traumatology Department, PTV Hospital, University of Rome “Tor Vergata” (Rome-IT); ²Orthopaedics Department, “Card. G. Panico” (Tricase-Lecce-IT)

Objective The aim of this study was to evaluate the reduction of pain, complications and results of Vessel-X® kyphoplasty, also known as vesselplasty, in the treatment of osteoporotic vertebral compression fractures (VCF) not responder to medical treatment.

Material and Methods From March 2006 to December 2007 we treated 136 VCFs in 110 patients, 81 women e 29 men (mean age 68 years). Procedures were managed by one or two C-arm fluoroscopic techniques. The highest level was D6 while more common were levels at the thoraco-lumbar junction. We always performed bilateral transpedicular minimally invasive approach using Vessel-X®, size 20 mm, with low-viscosity bone cement mixed with Osteo-G® (calcium phosphate). Pain was evaluated with Visual Analog Scale (VAS range, 0–10) and 36-item Short-Form Health Survey (SF-36) assessed at baseline, the day after the procedures and after 1, 6, and 24 months. All patients received an antiosteoporosis medical treatment, pain medication, and physiotherapy.

Results All patients have consistently shown a significant decrease of pain. In no case we reported pedicular or intracanal leaks of cement. Intradiscal leakages have happened in 9 levels (6.6% of total) but without local or peripheral symptoms. The average amount of cement injected, for each vertebral body, was 5cc (range 3.5–7 cc). Another vertebral collapse, within the first year after operation, took place in 14 patients, but only in 5 cases (3.6% of total) was an adjacent level.

Discussion During vesselplasty an artificial “vessel” system, the Vessel-X®, suitable with three sizes (20, 25 and 30 mm), is introduced into the vertebral body to achieve unilateral (or bilateral) transpedicular (or extrapedicular) augmentation after which low-viscosity bone cement, mixed with calcium phosphate, is injected into the vertebral body: the Vessel-X® are expanded to their predetermined configuration and a few bone void filler material penetrates through the “vessels” interdigitating the vertebral body, restoring the vertebral height, and reducing one of the most common adverse effects of other minimally invasive techniques such as cement leakage out of the vertebra.

Conclusions Vesselplasty is a safe and effective, minimally invasive procedure for relief of pain associated with VCFs, and improves mobility decreasing the potential risks associated with inactivity. We remind the importance of a global approach to the osteoporotic patients: the best treatment remains early diagnosis evaluating bone remodelling markers, lumbar and femoral Dual-energy X-ray absorptiometry (DEXA), thoracic and lumbar X-ray and risks fracture assessment to ensure an individual and best appropriated therapy as specific as possible.

PERIPROSTHETIC ELECTROMAGNETIC FIELDS GENERATED BY TITANIUM AND TITANIUM-BASED ALLOYS AS A NEW CAUSE OF SPINAL FUSION FAILURE

V. Denaro, N. Papapietro, S. Barnaba, L. Ruzzini, A. Sgambato, A. Cittadini

Università Campus Bio-Medico (Rome-IT)

Background Recent studies have pointed out that mechanically assisted crevice corrosion represents the initial failure of spinal implants, resulting in the local decrease of pH which leads to osteolysis.

Objective Analysis of retrieved instrumentation to better understand periprosthetic osteolysis and correlation of this information with clinical factors.

Study Design Posterior lumbar spine implants retrieved from patients affected by periprosthetic osteolysis were analyzed to identify corrosion and to investigate the electromagnetic fields generated by corrosion currents and their effect on human osteoblasts proliferation.

Methods Electrochemical analysis was performed to characterize the corrosion currents and the electromagnetic field generated around the implants retrieved. Human primary osteoblasts cultures were used to determine the effect of continue electromagnetic field stimulation on cell growth. Cultures were exposed to the electromagnetic field stimulation for 48 hours, 72 hours, 7 days and 14 days.

Results During the electrochemical corrosion tests both the screws and the bar showed a passivation current of 0.312 $\mu\text{A}/\text{cm}^2$ and 0.05 $\mu\text{A}/\text{cm}^2$ respectively. Osteoblasts exposed to an electromagnetic field of 12.1×10^{-6} T displayed a decreased proliferation rate. At each observation time, there were differences in cell numbers between the unexposed cells and the exposed cells.

Conclusions Aseptic periprosthetic bone loss can be due in part to the generation of electric and electromagnetic phenomena generated around metal devices which inhibit osteoblasts growth and might hamper periprosthetic bone formation. This mechanism is of clinical significance and should be more deeply evaluated.

HIP 3

ANALYSIS OF 110 BILATERAL HIP REPLACEMENTS PERFORMED IN SINGLE SESSION: THE ADVANTAGES FOR PATIENTS AND FOR THE NATIONAL HEALTH SYSTEM

F. Bove¹, A. Marconi¹, M. Mazzuca¹, F. Volpato¹, V. Schiavilla²

¹I.N.I. Istituto Neurotraumatologico Italiano di Grottaferrata (Grottaferrata-Rome-IT); ²Divisione di Ortopedia e Traumatologia, Ospedale Sant'Andrea, II Facoltà di Medicina e Chirurgia, Università "La Sapienza" (Rome-IT)

Background Patients suffering from bilateral hip osteoarthritis usually present clinical and radiographic findings, such as significant loss of the ROM, acetabular subchondral osteosclerosis and proximal femoral epiphysis deformity, similar on both sides. Usually these patients have to wait more than three months between hip replacements and often twelve months are spent between hospital and rehabilitation centres with a large loss of both time and money. Patients have been chosen for bilateral hip replacements since 1989. A bilateral procedure is psychologically (only one surgery), physically (only one anaesthesia) and in terms of rehabilitation time, beneficial to the patient. Time of surgery, blood loss, surgical access, hemostasis, intraoperative recovery were optimized. We consider a good method these objectives: a maximum time of 45 min for each hip replacement; reduction of blood loss by accurate hemostasis, autotransfusion, intra and postoperative recovery, adequate anaesthesia.

Material and Methods We have operated 110 patients between 1989 and 2007: 76 females and 34 males (range 28–81 years). There were 76 idiopathic hip osteoarthritis, 3 revisions and 141 secondary hip osteoarthritis. All patients were submitted to sub-aracnoid anaesthesia. During the operation blood was collected by

a special machine. A Bauer lateral approach was performed and in all patients cementless hip prostheses were implanted. Patients were encouraged to stand on the first day post-op. Rehabilitation was divided in three phases: verticalization, functional independence, strengthening and return to normal activity. Harris Hip Score was performed to evaluate results.

Results Intra-operative blood loss was an average of 850 cc of which 600 cc recuperated. In 86 patients we exclusively administered autotransfusion and in 24 cases we reintegrated losses with hemotransfusions. Follow-up was carried out for 10 years. Patients walked with the help of crutches for an average of 4.4 months and were submitted to clinical and radiographic evaluation. The mean R.O.M. was 100.3° flexion, 7.9° extension. H.H.S. preoperatively was 41.2 points; after 3 months the mean was 79 points, after 6 months 88.7, after 1 year 94.5 and after 10 years 93 points.

Conclusions Our experience with 110 patients submitted to bilateral hip replacement in a single stage showed the utility and the reduction of costs in relation to hospitalization and rehabilitation time.

PATTERNS OF CEMENT DISTRIBUTION IN TOTAL HIP RESURFACING ARTHROPLASTY

F. Favetti, F. Casella, M. Papalia, G. Panegrossi, F. Falez

Department of Orthopaedics and Traumatology, Santo Spirito in Sassia Hospital (Rome-IT)

Objective Currently accepted concepts in the area of total hip replacement are becoming increasingly focused on conservative procedures, both in surgical approaches and implants. Resurfacing hip replacement represents the less invasive femoral solution available for primary procedures, saving most of bone stock for future revisions and conceding a functional joint restoration that falls within physiological range. However, fixation at the bone-implant interface and preservation of biological integrity of retained bone have been questioned as a result of early failures due to neck fractures and avascular necrosis.

Material and Methods In this *in vitro* study four different resurfacing implants have been evaluated with simulated femoral head, two type of cement have been used (*low* and *high viscosity*), two different cementing techniques have been performed: *direct*, with apposition of cement directly on the femoral head and *indirect*, in which cement has been applied inside the femoral component. Each of resurfacing implants has been tested in both conditions for two times (low viscosity cement with indirect cementing technique and high viscosity cement with direct cementing technique).

Results High viscosity cement, performed with direct cementing technique, has shown a homogeneous distribution all over the femoral head, both in polar and in equatorial region with a mean value of cement radial penetration index of 4 mm. This condition is the same suggested in conventional cemented total hip arthroplasty. On the opposite low viscosity cement, performed with indirect cementing technique, has shown a massive cement polar concentration, with a peak of cement radial penetration index of 16 mm (mean values between 8–16 mm) with insufficient if not absent cement distribution in the equatorial zone.

Discussion Massive polar cement concentration could be held as a risk factor for early implant's failure. It could have two kind of effects on femoral head: biological effects (high local exothermic reaction with high local temperature (higher than 65°C), due to cement polymerisation could determine massive necrosis of the osteocytes) and biomechanical effects (excessive cement polar concentration could be responsible of an abnormal and uneven loads distribution on the femoral head that lead to concentrate the stresses all over the head-neck junction).

RELATIONSHIP BETWEEN THE SEVERITY OF HIP OSTEOARTHRITIS AND BONE QUALITY

E. Gasbarra, M. Celi, I. Cerocchi, L. Perticarini, R. Iundusi, U. Tarantino

Department of Orthopaedic Surgery, University Hospital Policlinico Tor Vergata (Rome-IT)

Bone mineral density (BMD) reduction is related to hip osteoarthritis. Aim of our study was to evaluate the relationship between low activity due to hip osteoarthritis and the variations of femoral and lumbar BMD evaluated by DXA and of biochemical markers of bone turnover and metabolism (serum calcium and phosphorus, PTH, vitamin D, B-ALP, osteocalcin, β -crosslaps, IL-6, TNF- α , osteoprotegerin). Data from 40 subjects (20 M and 20 F) older than 45 years who were admitted to undergo primary hip prosthesis due to hip osteoarthritis were compared to those obtained from 40 patients (20 M e 20 F) who received total hip replacement after a fracture of the proximal femur. In 70% hip fracture patients BMD evaluation indicated osteoporosis either at the lumbar spine or at the proximal femur or both and osteopenia in 30%. In 55% osteoarthritic patients low BMD was found, and the reduction in mineral content was directly related with the severity of hip osteoarthritis. Similar results were found in the data from blood analysis. This suggests that the reduction in the level of physical activity and deambulation, and above all the altered biomechanics and load distribution along the arthritic hip can cause both a systemic reduction of BMD and a condition similar to "disuse osteoporosis" in the areas of the femur in which trabecular bone is more represented (Ward triangle). What is more our results show that osteoarthritis has not a protective effect towards osteoporosis (especially in women with a low Body Mass Index) and that bone turnover is also accelerated in patients with hip osteoarthritis.

DIRECT AND INDIRECT MR-ARTHROGRAPHY IN THE DIAGNOSIS OF FEMORO-ACETABULAR IMPINGEMENT: A PRELIMINARY STUDY AND A COMPARISON BETWEEN THE TWO METHODS

G. Pozzi¹, P. Stradiotti², A. Zerbi³, S. Sironi¹

¹San Gerardo Hospital (Monza-Milan-IT); ²San Carlo Borromeo Hospital (Milan-IT); ³IRCCS Istituto Ortopedico Galeazzi (Milan-IT)

Introduction Femoro-acetabular impingement (FAI), which results from an abnormal relationship between the proximal femur and the acetabulum, is described as a major pathogenic factor in primary osteoarthritis of the hip. Two distinct types of FAI can be distinguished: "cam FAI", caused by jamming of an abnormal femoral head and "pincer FAI", that is the result of acetabular abnormality (coxa profunda, protrusio acetabuli or acetabular retroversion). These anomalies lead to abutment of the anterior femoral head-neck junction against the acetabular rim and can have detrimental effects causing labral and/or chondral lesion. The purpose of this study is to evaluate the efficacy of MR-arthrography (MRa) in detecting condral and labral defects in comparison to traditional MR.

Material and Methods From July 2007 to February 2008, 20 hip joints from 19 patients (M:F = 11:7; age 57 to 15; mean age = 35 years) with clinical and radiographical diagnosis of FAI underwent a traditional MR and indirect MRa (intra-articular diffusion of contrast medium after endovenous injection); 7 of them also underwent direct MRa (direct intra-articular injection of contrast medium); 2

of them underwent only direct MRa. Results were compared with the χ^2 test, using the traditional MR as control.

Discussion In our study we found 13 cam FAI, 1 pincer FAI, 1 mixed type (cam + pincer), 3 acetabular dysplasia and 2 normal hip. Traditional MR detected 6 condral lesions, while the indirect MRa detected 14 lesions ($p < 0.005$). Direct MRa did not show a significantly higher sensibility in comparison to indirect MRa ($p > 0.005$). In cam FAI we found a prevalence of antero-superior condral lesions (12 cases out of 13: 92.3%) with a labral degeneration in 10 cases, while only 4 postero-inferior condral lesions were found (36.4%). Traditional MR detected only 6 labral abnormalities while MRa detected 13 labral lesions.

Conclusions MRa is an indispensable instrument for the detection of condral and labral lesions and important data in the patient surgical planning. Indirect MRa has a significantly higher sensibility compared to traditional MR and a sensibility equal to that of the direct MRa. Indirect MRa should be the imaging modality of choice in detecting condral lesions in FAI.

ROLE OF HIP ARTHROSCOPY AFTER TOTAL HIP REPLACEMENT

N. Santori¹, F.S. Santori²

¹Rome American Hospital (Rome-IT), e-mail: nicsanto@libero.it;

²Ospedale San Pietro Fatebenefratelli (Rome-IT)

During the last few years hip arthroscopy is in continuous expansion and there is a growing number of new indications. Purpose of this presentation is to explain the role that, to our judgment, hip arthroscopy can assume in the patient bearer of THR. Two conditions mainly exist that can benefit of this type of approach. The first one regards patients with polyethylene wear and limited periprosthetic osteolysis which do not influence implant stability. Old patients with this radiographic appearance, occasional pain due to reactive synovitis and low level activity, if the implant is radiographically stable may benefit from arthroscopic synovectomy and poly debris removal. Elimination of a large amount of plastic foreign bodies brings to a halt the process of bone resorption which, if left untreated brings to implant loosening. The second indication is to increase our understanding of some causes of pain after total hip replacement and possibly to perform an arthroscopic treatment. Surgical technique, indications and clinical cases are presented.

KNEE 2

MODIFIED VERSUS TRADITIONAL SUBVASTUS APPROACH: WHICH IS THE BEST ONE? A CADAVERIC STUDY

R. Rossi, A. Maiello, M. Bruzzone, F. Dettoni, D. Bonasia, A. Marmotti, P. Rossi, F. Castoldi

Università degli Studi di Torino, Ospedale Mauriziano Umberto I (Turin-IT)

Objective The subvastus approach is defined the more anatomical approach in total knee arthroplasty (TKA). The objective of our study is to evaluate the real insertion of vastus medialis obliquus (VMO) tendon at the patella, the dimension of VMO tendon, its angle relative to long axis of the femur and quantified the amount and location of tendon and muscle damage after the traditional subvastus approach compared to that after a modified subvastus approach [1].

Material and Methods Twenty fresh-frozen cadaver knees (10 cadavers; 8 males, 2 females) were used. The traditional subvastus approach was assigned randomly; the modified subvastus was done in controlaterally.

Results The mean point of VMO insertion on patella was 42.5% (max 51.4% min 33.4%). The length of the VMO tendon from the lateral edge of VMO muscle to the closest point on the patella has a mean value of 26.1 mm (SD 4.0). The length of VMO tendon near lateral aspect of the patella has a mean value of 23.67 mm (SD 1.58). The triangle area of the VMO tendon has mean value of 271.54 mm² (SD 63.52 mm²). The mean angle between VMO fibers a long axis of the femur is 50° (SD 1.5). The extensor mechanism integrity is respectively of 80% in the modified subvastus and only 30% in the traditional subvastus technique. This study support that the modified subvastus approach is safer and less invasive than the traditional one. It is important to maintain the integrity of VMO tendon.

Discussion This study support that the modified subvastus approach is safer and less invasive than the traditional one [2].

Conclusions The risk is to tear the vastus medialis during the traditional subvastus technique.

References

1. Pagnano MW, Meneghini RM (2006) Anatomy of the extensor mechanism in reference to quadriceps sparing TKA. Clin Orthop 452:102
2. Pagnano MW, Meneghini RM (2006) Minimally Invasive Total Knee Arthroplasty with an optimized subvastus approach. J Arthr 21(4):22–26

TOTAL KNEE ARTHROPLASTY AFTER HIGH TIBIAL OSTEOTOMY

M. Giacobbe, I. De Martino, G. Gasparini

Orthopaedic Department, Catholic University (Rome-IT)

In the follow-up of high tibial osteotomy (HTO), when the clinical and radiographic examination shows the progression of arthritis, is necessary convert HTO in a total knee arthroplasty (TKA). There are some technical problems related to the previous HTO; they are due to the level of osteotomy, to the surgical approach, to the hardware used and to the time in which it is removed. The anatomical changes caused by a previous HTO consist of: different amount of bony deformity both on the frontal and the sagittal plane, loss of bone stock, patella lowering, soft tissues scarring determining surgical wound healing and ligamentous balance problems.

A suitable surgical technique requires a careful planning of skin incision, an accurate management of the extensor mechanism in order to avoid patellar tendon avulsion (lateral release, femoro-patellar ligament section and quadriceps snip are frequently needed), a progressive exposure (especially on the lateral side where the capsule becomes fibrous, retracted and closely sticked to the epiphysis). Tibial cut has to be planned very carefully, establishing an adequate posterior slope. Major bone stock loss will be compensated with metal augments available if a revision prosthesis system is provided. Ligament balance has to be progressive and in all cases posterior cruciate ligament must be sacrificed. In case of collateral ligaments iatrogenic damage a revision prosthesis systems with a higher level of stability has to be available. In case of patellar malalignment, further lateral release will be necessary.

Results of TKA after HTO are discordant both in terms of function and in terms of duration; some authors report results superimposable to those of primary TKA, while in other papers results are comparable to those of TKA revisions. In any report a greater percentage of complications is described, in particular problems of wound healing, infections, greater blood loss, patellar tendon avulsion and patella subluxation.

RESULTS OF A PROSPECTIVE STUDY ON AN ARTHROSCOPIC-ASSISTED TECHNIQUE FOR LATERAL TIBIAL PLATEAU FRACTURES

R. Rossi, D.E. Bonasia, D. Blonna, M. Assom, A. Marmotti, P. Rossi, F. Castoldi.

Ospedale Mauriziano “Umberto I” di Torino, Università degli Studi di Torino (Turin-IT)

Objective This study reports the 5-year clinical and radiological outcomes of a simple arthroscopic-assisted technique for Schatzker type II and III tibial plateau fractures, without bone grafting. Forty six patients (46% males, 54% females, average age 48 years, SD 13.6 years), with tibial plateau fractures Schatzker type II (41%) and III (59%), underwent an arthroscopic-assisted technique conceived to use a compacted cancellous bone graft, taken from the medial metaphyseal side of the tibia, and a percutaneous fixation.

Material and Methods The patients were prospectively followed-up at one, three and five years from surgery. Independent assessments were carried out using Knee Society Score, HSS score and Rasmussen’s clinical and radiological scores. At 5-year follow-up patients underwent a weight-bearing radiograph of both limbs.

Results At last follow-up evaluation Knee Score (average 93.2, SD 7.7) was excellent in 37 patients (80%), good in six (13%), fair in three (7%). Function Score (average 94.8, SD 8.51) was excellent in 38 patients (83%), good in five (11%), fair in three (6%). HSS score (average 93.4, SD 8.23) was excellent in 41 patients (89%), good in five (11%). The average Rasmussen clinical score was 28.2 (SD 1.4). The radiological Rasmussen score was excellent in five patients (11%), good in 39 (85%) and fair in two (4%). In the weight-bearing radiographs a valgus deviation was present in four patients (8.7%).

Discussion and Conclusions Arthroscopic-assisted technique for lateral tibial plateau fractures without bone grafting has outcomes encouraging and comparable to the results of other techniques that use either iliac crest graft or bone substitutes.

UNIDIRECTIONAL ROTATING PLATFORM TKA WITH SURFACE-CEMENTATION TECHNIQUE OF TIBIAL COMPONENT: A PROSPECTIVE STUDY

R. Rossi, A. Ferro, M. Bruzzzone, D. Bonasia, P. Rossi, G.L. Collo, F. Castoldi

Ospedale Mauriziano “Umberto I” di Torino, Università degli Studi di Torino (Turin-IT)

Objective The higher conformity of rotating platform design and the possible rotary forces to the tibial platform may produce higher micromotion when the tibial stem remains cementless (hybrid fixation) with an earlier loosening [1].

Material and Methods The purpose of this prospective study was to evaluate 70 consecutive unidirectional rotating platform posterior stabilized TKAs (NexGen-Zimmer) using a surface tibial cementation with a press fit technique of the tibial stem. The mean follow-up time was 39 months (range 29–69). There were 46 women and 24 men with a mean age 72 years (85–55). Knee Society Score (KSS) and Knee Society Roentgenographic evaluation were utilized. Moreover, the cement mantle bone penetration was measured dividing the tibial component in 4 zones.

Results The Knee Score was 52 (SD = 15.2) preoperatively and 91 last visit follow-up. The Function score was 41 (SD = 23) preoperatively and 86 (SD = 17) at last follow-up. Five patients had radiolucency lines at the tip of the tibial stem, but they were totally asymptomatic. The

mean cement mantle under the tibial surface were respectively 2.3 mm. (± 0.7) in zone 1, 3.1 mm. (± 0.6) in zone 2, 2.9 mm. (± 0.7) in zone 3 and 2.6 mm (± 0.8) in zone 4. No cases of early loosening or osteolytic lesions were observed. No revisions were performed for any reason.

Discussion The implant stability was guaranteed by the cement mantle penetration that should be 3 mm around the surface of the tibial trail [2].

Conclusions The present cementation technique of tibial component provides good results at short term follow-up.

References

1. Luring C, Perlick L, Trepte C et al (2006) Micromotion in cemented rotating platform total knee arthroplasty: cemented tibial stem versus hybrid fixation. *Arch Orthop Trauma Surg* 126:45–48
2. Bert JM, McShane M (1998) Is It Necessary to Cement the Tibial Stem in Cemented Total Knee Arthroplasty? *Clin Orthop* 356:73–78

POSTERIOR STABILIZED VERSUS ULTRACONGRUENT POLYETHYLENE IN TOTAL KNEE ARTHROPLASTY: A CLINICAL RANDOMIZED PROSPECTIVE STUDY

I. De Martino, M. Giacobbe, G. Gasparini

Orthopaedic Department, Catholic University (Rome-IT)

The excellent results of the posterior stabilized (PS) implants in total knee replacement (TKR) are largely recognized. Nevertheless, some disadvantages are described: removal of large bone stock, paradoxical kinematics, wear or disruption of the post, post-cam dislocation (short horizontal and vertical jumping distances). On the other hand, the polyethylene wear continues to represent the major cause of failure in primary TKR. The ultracongruent polyethylene component has a deeper concavity with an elevated anterior lip that is conforming in the sagittal plane with the femoral component imparting anteroposterior stability without needing a central cam and post. This insert may decrease polyethylene debris formation so reducing osteolysis and loosening, allows saving the intercondylar femoral bone decreasing the risk of fracture and preserving bone stock for possible revisions and permits a more physiological kinematics and distribution of the loads. Furthermore an ultracongruent component has increased jumping distances that reduce the risk of dislocation. We performed a clinical randomized prospective study on 50 patients with primary osteoarthritis who received the same computer-assisted TKR using a CT-free navigation system. In all patients the posterior cruciate ligament was resected: in 25 PS tibial and femoral components were implanted whereas in 25 an ultracongruent tibial polyethylene was coupled to a cruciate retaining femoral component. There were 37 females and 13 males with an average age of 71 years, with a maximum follow-up of three years. Flexion increased from 65° to 113°, whereas range of motion improved from 62° to 112°. HSS score increased from 31 to 93 at the last follow-up. There were no statistical differences between two groups in the mean range of all examined parameters. The ultracongruent sagittal conforming component may reduce the polyethylene wear so increasing the implants survivorship; preserving the femoral intercondylar bone, the ultracongruent implant may improve the results of possible revisions. Further longer term investigations are necessary on larger series.

FLEXION AFTER TOTAL KNEE ARTHROPLASTY: FIXED BEARING VERSUS ROTATING TIBIAL PLATFORM

A. Bistolfi, G. Massazza, E. Graziano, D. Testa, E. Balboni, C. Olivero, F. Lagalla, E. Cenna, M. Crova

Department of Orthopaedics and Traumatology, University of Turin, AO CTO (Turin-IT)

Introduction Mobile bearing tibial platforms have been developed to improve clinical function and to reduce the wear of polyethylene in total knee replacements (TKR) [1]; nevertheless, the real effectiveness of these implants for duration and range of motion is still controversial [2, 3]. While duration is subjected to many variables, the range of movement is an important parameter for a successful TKR which can be evaluated at short-term. The aim of this study is to compare the postoperative flexion of fixed bearing and rotating platform for the same model of TKR.

Material and Methods The Nexgen LPS knee system for arthroplasty (Zimmer, Indiana, USA) has been evaluated: the fixed bearing system (FB) has been used from 1998 to 2000, while the rotating platforms (RP) have been introduced in 2000 and in 2001 became the only used. The FB group consists of 95 FB TKR (86 patients, 80% female, mean age 68.5 years, arthritis in 95%); the RP group consists of the first 100 RP TKR implanted. Age, gender and pathology of the two groups are comparable. The TKR have been evaluated with the Knee Society Score and with preoperative and postoperative measurements of the active-assisted flexion of the knee.

Results Two FB implants have been revised for instability, while one RP implant has been revised for infection. The percent of minor complications (deep venous thrombosis, stiffness, wound delayed healing and nerve palsy) have been comparable in the two groups. Mean range of postoperative flexion for the FB was 108° (IC 95%: 100.2°–112.8°), whereas that for RP was 110° (IC 95%: 105.4°–114.6°). No statistically significant difference in flexion was demonstrated between FB and RP tibial insert in TKR.

Discussion and Conclusions The surgical technique has been the same in all cases. The nature of the study, regarding the choice of the implant which did not undergo selections and the similarity of the populations, made the groups comparable. The theoretical advantages of the RP are interesting: wear tests in-vitro demonstrated that the rotational freedom decreases the stresses on the tibial polyethylene, while there is no evidence of increased backside wear. On the contrary, no TKR design whether fixed or mobile bearing has been demonstrated to reproduce the natural kinematics of the knee. This study does not indicate any difference between the two groups for functionality and patients satisfaction, while further studies are indicated for long term duration and polyethylene wear.

References

1. Delpont HP, Banks SA, De Schepper J, Bellemans J (2006) A kinematic comparison of fixed- and mobile-bearing knee replacements. *J Bone Joint Surg Br* 88(8):1016–1021
2. Banks S, Bellemans J, Nozaki H, Whiteside LA, Harman M, Hodge WA (2003) Knee motions during maximum flexion in fixed and mobile-bearing arthroplasties. *Clin Orthop Relat Res* (410):131–138
3. Dennis DA, Komistek RD, Mahfouz MR, Haas BD, Stiehl JB (2003) Multicenter determination of in vivo kinematics after total knee arthroplasty. *Clin Orthop Relat Res* (416):37–57

RETAINED VERSUS RESECTED POSTERIOR CRUCIATE LIGAMENT IN TOTAL KNEE ARTHROPLASTY: A PROSPECTIVE RANDOMISED STUDY

D. Gigante¹, N. Orlando¹, A. Verdenelli¹, S. Ceccarelli², F. Greco¹

Department of Orthopaedics, ¹Polytechnic University of Marche and ²Senigallia (Ancona-IT)

Objective Many current TKR derive from two principal categories: anatomic and conforming design; in either the choice between retaining or resection of posterior cruciate ligament (PCL) is controversial. The clinical results with one design can-

not be readily extrapolated to a different design. Thus, we performed this prospective randomised study in order to compare in the same prosthetic design the clinical-radiographic results at a follow-up of four years of a retained vs. a resected posterior cruciate ligament total knee arthroplasty (GKS Prime® system, Permedica, Merate, Italy).

Material and Methods One hundred consecutive tricompartmental osteoarthritis with varus knee which should be replaced using cemented total knee arthroplasty (23 men, mean age 70.1; 77 women, mean age 72.0) were randomised into two groups: (A) retained PCL (41 knees) and (B) completely resected PCL (59 knees). They were well matched and no patient was lost during follow-up. All the operations were performed by the same surgical equipe from 2000 to 2004. Clinical and radiographic evaluation was performed by the Knee Society Score (KSS) pre-operatively and at 6, 12, 24, 36, 48 months of follow-up. Visual Analogical Score (VAS) and patient satisfaction (expressed in 5 levels) were also considered at 12 and 48 months. Statistical analysis was performed by Student *t*-test for unpaired data.

Results No case of infection was observed. Relief from pain, correction of deformity, stability and function were comparable in both groups: KSS was 94 (83–100) in group A and 97 (86–100) in group B, this difference was not statistically significant ($p > 0.05$). The mean of knee flexion was 109° in group A and 119° in group B; this difference was statistically significant ($p < 0.01$). The mean of level of satisfaction was 3.5 in group A and 4.1 in group B; this difference was statistically significant ($p < 0.01$). Some radiolucencies were observed at the tibial medial site in 1, 2, 3 and 5 zones (8% of cases in both groups; no differences between groups), but none was awaiting revision for loosening at 4 years follow-up.

Discussion By clinical and radiographic results, we cannot support a clear advantage between the retaining or resection of PCL in our prosthetic model. The greater satisfaction and knee flexion of patients belonging to group B, associated with a better articular cleaning during surgery, lead us to prefer the resection of PCL.

Conclusions To date a study with a longer follow-up is performed to define wear and mobilisation of prosthetic components in the same patients.

A COUTOURED ARTICULAR PROSTHETIC DEVICE FOR TREATING KNEE CARTILAGE DEFECTS: A 2-YEAR FOLLOW-UP STUDY

A. Schiavone Panni, M. Tartarone, D. Santaiti, C. Mazzotta, S. Cerciello, M. Vasso

Department of Science for Health, University of Molise (Campobasso-IT)

Background Treatment of articular cartilage defects offers a great variety of options depending on the severity of the damage. The main factors to be considered are: patient age, size of the lesion, location of the defect and no other joint damages. A contoured articular prosthetic (HemiCAP®, Arthrosurface) was developed as a partial resurfacing device of femoral condylar surface when only one compartment is affected by localized cartilage damage neither fit for biological repair methods, nor for traditional resurfacing techniques such as unicompartmental or total joint replacement.

Purpose The purpose of this retrospective analysis was to evaluate the medium-term results of 10 consecutive patients who underwent partial femoral resurfacing with HemiCAP system in a period between February 2005 and December 2006. This procedure is indicated in middle aged patients (>40 years) with symptomatic full-thickness articular cartilage defects of the femoral condyles (between 10 and 20 mm in diameter), with no kissing lesions, no

previous meniscectomy and normal weight-bearing axis or no more than 7° of varus.

Methods The average patient age was 54.2 years (range, 46–61 years), one male and nine females. The average follow-up was 24 months (range, 9–32 months). Pre-operative data were collected using IKS and Womac scoring systems, as well as radiographic assessments and MRI evaluation. Some cases (30%) underwent also an arthroscopic evaluation.

Results In all patients we observed the resolution of knee pain in many activities of daily life (such as walking, sitting, standing and climbing stairs) and recovery of full range of motion in three months after surgical treatment. Only one patient reported knee pain after sport activity with an internal “clunk” sensation during full knee extension. In no case we have observed neuro-vascular lesions. The mean IKS score significantly improved from 118 pre-operatively to 178.2 postoperatively. The mean Womac score improved from 88 preoperatively to 15.3 postoperatively.

Conclusions Our study suggests that Arthrosurface HemiCAP system represents a viable alternative to treat symptomatic full-thickness chondral defects of the femoral condyles in very appropriately selected cases providing successful medium-term clinical outcomes. However, further studies with long-term follow-up are necessary to confirm these encouraging results.

HIGH-FLEX TOTAL KNEE ARTHROPLASTY: OUR EXPERIENCE

D. Rosa, S. Guarino, A. Russo, P. Attingenti, M.G. Panterli

Department of Surgical Sciences, Orthopaedics, Traumatology and Emergency, University “Federico II” (Naples-IT)

Background Total knee arthroplasties (TKA) are validated surgical procedures with guarantee of good clinical results in the 90% of the cases up to 15–20 years after surgery. Besides resolution of pain and knee deformity, the new prosthetic designs should allow a complete recovery of the ROM especially in younger or more active patients who need knee flexions over 120° to carry out their activities (such as sport, religious prayer, hobbies). These clinical demands have led to new implants defined as high-flex prostheses. The purpose of this study is to evaluate the biomechanical features of the high-flex total knee prostheses and we report the results of comparing standard fixed-bearing versus high-flex total knee arthroplasty.

Material and Methods At the Department of Orthopaedic Surgery of the University “Federico II” a retrospective study was conducted to compare clinical results of a standard fixed-bearing total knee design (AGC - Biomet) versus a high-flex (CR) total knee design (Vanguard - Biomet). Sixty-eight TKA, 35 AGC and 33 Vanguard, were performed in 68 patients from April 2004 to February 2007. There were no essential differences between the two groups. All implants were cemented, while the patella has never been resurfaced. Mean follow-up was 20 months (11–45). Clinical results were evaluated using the Knee Society Scale (KSS) and the Visual Analogic Scale (VAS); the ROM has been assessed by the use of a standard clinical goniometer and moreover the ability of squatting and the level of satisfaction were investigated. The quality of the implantation was analysed on X-ray.

Results Among patients with AGC prosthesis, Functional Score (FS) was 82.3 (54.1 preoperatively) and Knee Score (KS) was 90.2 (48.2 preoperatively); at follow-up of Vanguard-replaced patients FS was 83.6 (53.8 preoperatively) and KS was 91.8 (47.5 preoperatively). The level of subjective satisfaction was excellent and good in 90% of the cases. The mean preoperative angle of flexion was 96° in the standard group and 98° in the high-flex group. At follow-up, we observed the mean angle of flexion was 118° in the first

group and 133° in the second group and the rate of patients able to squat was significantly higher in the high flex group than the rate in standard group. Both the TKA groups showed a satisfactory correction of the clinical and x-graphic deformity.

Conclusions This study reveals better results at short-mid term follow-up for the high-flex implanting design in terms of the angle of flexion and the ability of squatting, with no discrepancy for the Knee scores.

KNEE 3

MANAGING BLOOD-LOSS AFTER TKA

A. Bistolfi, D. Testa, F. Lagalla, C. Olivero, G. Massazza, L. Drocco, G. Colzani, F. Rosso, M. Crova

Department of Orthopaedics and Traumatology, University of Turin, AO CTO (Turin-IT)

Introduction Blood-loss in total knee replacement (TKR) is a relevant problem, which usually requires blood transfusions [1, 2]. Since transfusions are not risks-free, several procedures are used to reduce intrarticular bleeding: during the surgery tourniquets and haemostasis, after surgery pro-coagulant drugs, compressive bandaging, clamping suction drainages and, recently, a 90°-flexion procedure [3] are used. We evaluate the efficacy of the flexion positioning and of the suction of the drainages in reducing blood-losses.

Material and Methods Patients with TKR have been randomly divided into 4 groups. Group-A, 15 pts: flexed knee, drainage without suction 12 h and with suction 36 h. Group-B, 9 pts: knee flexed, suction drainage 48 h. Group-C, 13 pts: extended knee, drainage without suction 12 h and with suction 36 h. Group-D, 15 pts: knee extended, suction drainage 48 h. The same surgical technique has been used in all cases; the intra-articular drainage was removed at 48 h. A dedicated form was developed to evaluate: progressive blood-loss, haemoglobin loss, blood transfusion, analgesic peri-femoral nerve infusion, pain (patients have been asked to give a score from 1 to 100).

Results Blood-loss detected into the drainages at 48 h are the followings: Group-A 598 cc, Group-B 542 cc, Group-C 597.69 cc, Group-D 640 cc; haemoglobin loss at 24 h: Group-A 3.59 mg/dl, Group-B 3.98 mg/dl, Group-C 3.46 mg/dl, Group-D 4.01 mg/dl. We observed no statistically-significant difference between the single groups neither in term of haemoglobin or blood-loss. Transfusions have been performed for Group-A in 86.7% of the cases, Group-B in 66.7%, Group-C in 69.2% and Group-D in 55.1%. In Group-C and D (extended) mean pain value was 26/100 with analgesia and 37/100 without, while for the groups A and B (flexed) was around 40/100 and 60/100, respectively. None of the TKR had problems with wound healing or range of motion.

Discussion The procedure of Group-B appears the most effective in reducing blood-loss, while a suction drainage for 48 h seems to give the higher blood-loss, independently from the association with flexed or extended knee. No significant differences have been detected about haemoglobin loss. The flexion position is painful and not tolerated by many patients; it requires increased analgesia and is difficult to manage for nurses: therefore it has been abandoned; on the contrary a non-suction drainage for the first 12 h is a simple, safe and useful procedure to reduce blood-loss. According to these results, even not statistically significant, the knee position and the suction of the drainage have influence on intrarticular post-operative blood-loss.

References

1. Berman AT, Geissele AE, Bosacco SJ (1988) Blood loss with total knee arthroplasty. Clin Orthop Relat Res 234:137–138

2. Cushner FD, Friedman RJ (1991) Blood loss in total knee arthroplasty. Clin Orthop Relat Res 269:98–101
3. Timlin M, Moroney P, Collins D, Toomey D, O'Byrne J (2003) The 90/90 pillow reduces blood loss after knee arthroplasty. a prospective randomized case control study. J Arthroplasty 18(6):765–768

EXTRACORPOREAL SHOCKWAVE TREATMENT OF EARLY SPONTANEOUS OSTEONECROSIS OF THE KNEE

M. Vitali¹, C. Sosio², G. Peretti³, L. Mangiavini², G. Frascini²

¹Recidency Program in Orthopaedic and Traumatology I, University of Milan (Milan-IT); ²Department of Orthopaedics and Traumatology, San Raffaele Scientific Institute (Milan-IT); ³Faculty of Exercise Science, University of Milan (Milan-IT)

Objective We report eleven cases of early spontaneous osteonecrosis (SO) of the knee successfully treated with an extracorporeal shockwave treatment (ESWT). Traumatic and vascular theories were proposed as the cause of the SO, lack of blood in some critical areas, such as subchondral bone of femoral condyles or tibial plateaus, was considered the underlying condition of this pathology. ESWT can be suggested as an effective conservative treatment for SO of the knee.

Material and Methods Ten patients with medial femoral condyle osteonecrosis of the knee (one bilateral) were evaluated. Exclusion criterion was evidence of a structural collapse of subchondral bone. Two patients had received a femoro-popliteal by-pass within the last year, while others five presented a deficit of the vascular axis of the homolateral lower limb documented by an eco-color Doppler. A clinical evaluation was taken at the diagnosis using KSS, PPI, NRS and VAS. Plain radiographs and MRI confirmed the diagnosis of osteonecrosis. Patients were treated with a cycle of three ESWT performed with 2000 pulses of 0.28 mJ/mm² with Wolf Piezoston 300 with 6.5 MHz ultrasounds for three times in a month. Clinical evaluation was performed at first and at third month after treatment and a MRI evaluation was performed at fourth month after treatment.

Results Clinical evaluation showed a significant improvement of symptoms and articular functionality. MRI of all cases revealed the continuity of the cartilage with a reduction in bone marrow edema and no collapse of lesion.

Discussion In our study, a single cycle of ESWT produced an improvement of the clinical and MRI aspects in eleven cases of SO of the knee. The neo-angiogenetic effect of the ESWT appears to accelerate the time for the symptom remission. ESWT might have the potential to avoid the need for surgical treatment.

INTRA-ARTICULAR BLEEDING CONTROL AFTER TOTAL KNEE ARTHROPLASTY USING A MULTIMODAL APPROACH

A. Baldini, P. Indelli, B. Barbanti, L. Manfredini

Casa di Cura Santa Chiara (Florence-IT)

Excessive intra-articular bleeding after total knee arthroplasty (TKA) may require the use of autologous or allogenic blood transfusion, and may produce knee joint swelling which slows down postoperative rehabilitation.

Fifty TKA patients (group A) operated between January 2006 and July 2007 were compared to a matched cohort of fifty patients (group B) who underwent TKA by the same surgeon using a multimodal blood saving approach with the following strategies: (1) pre-

operative classes focused (prescription of oral iron and folate, use COX-2 suspend NSAIDS); (2) pre-operative planning with expeditious procedure (operative time <50 min) – limited parapatellar approach; (3) no tourniquet use with surgical phases performed in deep flexion; (4) pericapsular injections (ropivacaine and adrenalin after skin incision); (5) saline and adrenaline soaked sponges; (6) extramedullary femoral and tibial instrumentation; (7) oxidized and regenerated cellulose resorbable gauze in the suprapatellar pouch; (8) IV Tranexamic acid 10 mg/kg intraoperatively plus 3, and 6 hours postoperatively; (9) operated limb kept 3 postoperative hours at 70–90° flexion with cryotherapy; (10) postoperative drainage (24 hours) with reinfusion system.

Adopting a surgical technique and a postoperative protocol focused on blood saving reduces transfusion rate and improves postoperative recovery after TKA.

Table 1 Results

	Group A	Group B	<i>p</i> -value
Trasfusion rate (%)	18	4	0.001
Hemoglobin drop (g/dl)	4.6	3.1	0.02
Postoperative blood loss (ml)	850	450	0.01
Major knee swelling ($\phi > 4$ cm)	18%	7%	0.001
Straight leg raise (days)	1.4	3.3	0.03
90° passive flexion (days)	2.6	4.7	0.05

PATELLAR MANAGEMENT IN TOTAL KNEE ARTHROPLASTY

A. Schiavone Panni, M. Tartarone, S. Cerciello, M. Vasso, D. Santaiti, C. Mazzotta

Department of Science for Health, University of Molise (Campobasso-IT)

Patello-femoral complications represent a frequent problem after total knee arthroplasty. They cause patient discomfort or pain and severe decrease in quality of life and may be responsible of almost 20% of re-operations. Thus, the decision of resurfacing the patella or not is a crucial moment in preoperative planning and this choice may influence the surgical options. Unfortunately no strict scientific criteria have been proposed, and this decision is influenced by preoperative considerations or intraoperative findings; so this choice is often individual and is influenced by surgeon's skills. In case of obese patients or inflammatory pathology or in case of severe patello-femoral arthritis, patella replacement should be considered. In this case some surgical tips have must be followed: patellar bony resection should be parallel to the anterior femoral cortex in order to avoid asymmetrical resections which may lead to patella instability. Hypo resection should be avoided, since they may cause overstuffing with patello-femoral ligament stiffness. Hyper resection is even more dangerous since bone stock loss increase the risk of patellar fracture, moreover surgeons have to consider the risk of reoperation with possible patellar revision. Thus at least 15 mm of patellar bone should be conserved after resection. PE component should be implanted in the supero-medial aspect of the bony patella. In case of non obese patients, in absence of inflammatory arthritis and in case of mild patello-femoral arthritis the retention of the bony patella may be proposed. In such cases patellar shape should match with the prosthetic trochlea and some tips may decrease the risk of anterior knee pain. Denervation, osteophytes removal or tangential resections may increase patello-femoral congruence and reduce patellar thickness. Regardless the chosen option concerning patellar management, internal rotation of both femoral and tibial component, femoral component oversizing and joint line variations should be avoided.

TOTAL KNEE ARTHROPLASTY WITH OR WITHOUT TOURNIQUET: A PROSPECTIVE NON-RANDOMIZED STUDY

G. Cinotti, N. Luciola, E. Ferrari, A. Greco

I Orthopaedic Clinic, University of Rome "La Sapienza" (Rome-IT)

Introduction The tourniquet is currently used in total knee arthroplasty (TKA) to improve the visualization of the operative field and the accuracy of bone and ligamentous procedures. However, the tourniquet may be a potential source of perioperative complications including an increased risk for DVT and postoperative bleeding. Aim of the present study was to assess whether there is any significant difference in the postoperative course of patients submitted to TKA with or without tourniquet.

Material and Methods Two groups of patients who underwent TKA were prospectively evaluated: group 1, including 55 patients (23 men and 32 women) in whom the tourniquet was inflated before skin incision e deflated just before the closure of the arthrotomy; group 2, including 30 patients (12 men and 18 women) in whom the tourniquet was inflated just before cementing and deflated soon after it. All patients were evaluated in the postoperative course and at least 1 year after surgery.

Results In group 1, the average blood loss in the first 24 hours was 460 ml (range 370–690); after 36 hours, Hb level was, on average, 1.9 mg/dl lower compared to the preoperative value. In group 2, the average blood loss in the first 24 hours was 370 ml (range 290–510) ($p < 0.05$); the Hb level was reduced, on average, 1.7 mg/dl compared to the preoperative value ($p > 0.05$). Clinical evidences of suspected DVT were present in 6 patients of group 1 and in 2 patients of group 2. The ultrasonographic evaluation confirmed the diagnosis of DVT in 3 patients of group 1 and in no patients of group 2 ($p > 0.05$).

Conclusions In patients submitted to TKA with the tourniquet, the postoperative blood loss was found to be higher than in those in whom the tourniquet was used only during cementation of the implant. However, the overall reduction in the Hb level, compared to the preoperative value, did not differ significantly between the two groups. Controversy exists on possibly increased risk of DVT using the tourniquet. In this limited number of patients, we found a non-significant increase of DVT in patient operated on with the tourniquet compared to those without it.

ANATOMICAL STUDY ON LATERAL MENISCAL TRANSPLANTATION: AN ORIGINAL ARTHROSCOPIC TECHNIQUE DEVELOPED ON 12 CADAVER SPECIMENS

L. Panarella¹, U. Tarantino¹, G. Puddu², N. Bélot³, P. Boisrenoult⁴, P. Beaufils⁴

¹University of Rome Tor Vergata (Rome-IT); ²Valle Giulia Private Hospital (Rome-IT); ³University of Rennes (Rennes-FR); ⁴Hospital Center of Versailles (Le Chesnay-FR)

Background Meniscal transplantation is still discussed as a valuable technique in the treatment of degenerative osteoarthritis of the knee. However it seems to be effective in the post-menisectomy syndrome, especially in patients with a normal knee alignment. The objective of this anatomical study was to verify the feasibility of an all-arthroscopic lateral meniscal transplantation.

Methods An original arthroscopic technique was developed on 12 cadaver specimens and was performed through the two standard antero-medial and antero-lateral approaches. The fixation was

secured through two bone plugs into two orthogonal tunnels. Six fresh right knees and six fresh left knees were tested. We carefully preserved meniscal insertions on the anterior and posterior horns during the preparation of the transplant from the meniscal bank. Through the arthroscopic portals, the graft was secured on the two tibial tunnels and fixed all over the menisco-synovial junction. At the end of the procedure, all the specimens were tested for anatomical positioning and mechanical resistance of the graft after dissection of the knee joint.

Results Progressing with the technique, the overall position of the lateral meniscus on the knee joint was found to be more and more adequate. The mechanical resistance to pull-out improved according to bone plugs positioning, as well.

Conclusions Bone plugs quality, correct meniscal sizing and careful dissection of the menisco-synovial junction are mandatory to ensure a good preparation of the meniscal transplant. Despite a large number of papers, meniscal transplantation can not be defined a standard treatment. We believe that this technique could be further evaluated to perform lateral meniscal allograft with a less invasive procedure.

PROSPECTIVE RANDOMIZED STUDY TO EVALUATE THE EFFECT OF A NEW METHOD OF INTRAOPERATIVE COAGULATION BY RADIOFREQUENCY BIPOLAR SEALER VERSUS CONVENTIONAL METHOD BY ELECTROCAUTERY IN TOTAL KNEE REPLACEMENT SURGERY

P. Caldora¹, E. Nizami¹, D. Lup¹, R. Guarracino¹

¹U.O. Ortopedia e Traumatologia, Ospedale S. Margherita Valdichiana (Cortona-IT)

Objective The aim of this prospective, randomized study is to evaluate the effect of a new irrigated radiofrequency bipolar sealer (Aquamantys 6.0 TM, Tissuelink) on blood loss and postoperative recovery in patients undergoing total knee replacement (TKR).

Material and Methods Forty patients undergoing primary TKR were randomized in two groups. The group A consists of twenty patients in which the bipolar sealer Aquamantys 6.0TM was used, while the group B consists of twenty patients in which a conventional electrocautery was used. Exclusion criteria were: grave heart diseases, platelet level <150,000, serious vascular peripheral diseases, known coagulation diseases, preoperative haemoglobin <12 g/dl, preoperative haematocrit <36%. The protocol includes detailed clinical examinations during the stay in hospital, before surgery and 4 hours, 24 hours, 2 days, 3 days, 4 days after surgery, and on the day of discharge; besides that, clinical examinations after 1 and 3 months. In all the patients we used the same antithrombotic prophylaxis, always haemostat snare, the same surgical technique, the same implant, and the same rehabilitative protocol.

Results The evaluated criteria were: loss of blood during the operation, minimum level of postoperative haemoglobine, postoperative haematomas, number of transfusions, reduction of oedema and pain, postoperative ROM. Preliminary data show a difference as to the decrease of postoperative haemoglobin, overall loss of blood and minimum levels of postoperative haemoglobin, with a greater effectiveness of the Aquamantys system as intraoperative coagulation. The decrease of the level of haemoglobin in group A was 19% inferior to that in group B; the overall loss of blood in group A was 15% inferior to that of group B while the maximum level of the haemoglobin decrease in group A was 20% smaller than in group B. As secondary end points we detected a significant reduction of postoperative pain and edema in group A as well as a faster recovery of ROM immediately after the surgery.

Conclusions In the TKR surgery, the system of intraoperative coagulation Aquamantys has proved efficacious in the decrease of postoperative loss of blood with a reduction of pain and oedema and with a faster recovery of postoperative ROM.

TRAUMATOLOGY 3

ARTHROSCOPIC MANAGEMENT OF TIBIAL PLATEAU FRACTURES

R. Buda, F. Di Caprio, R. Ghermandi, M. Cavaciocchi, S. Giannini

Rizzoli Orthopaedic Institute, University of Bologna (Bologna-IT)

Objective Arthroscopic assisted reduction and percutaneous fixation was widely described for the treatment of tibial plateau fractures. If a depressed fragment is present, bone grafts or substitutes are commonly used after reduction of the fragment. Aim of this study was to evaluate the functional and radiographical outcome of arthroscopic management of tibial plateau fractures avoiding the use of bone grafts or substitutes.

Material and Methods From January 2000 to October 2003, 58 consecutive patients with Schatzker type I-IV tibial plateau fractures. All patients underwent arthroscopic assisted reduction and percutaneous screw fixation. Bone grafts or substitutes were never used. Clinical evaluation at follow-up was performed using the IKDC form. Radiographic evaluation was performed on weight-bearing plain radiographs of both knees by Rasmussen anatomical grading and Ahlback osteoarthritis scale. In fractures with a depressed fragment (types II-III), the amount of the residual depression at follow-up was measured.

Results At a mean follow-up of 48.8 months (range: 36–77), the mean functional score with IKDC Subjective Evaluation was 82.1. 52 patients (89.6%) were classified as IKDC A or B. The mean Rasmussen anatomical grading scored 16.4; two patients had an Ahlback grade II post-traumatic osteoarthritis. The mean residual depression at follow-up was 0.66 ± 0.94 mm (min 0; max 3) in type II, and 2.38 ± 1.44 mm (min 0; max 4.3) in type III fractures.

Discussion Arthroscopic management provides satisfactory results for tibial plateau fractures. The results do not depend only on the radiographical quality of reduction, but also on many other factors, such as intra and extra-articular associated lesions and their treatment, and previous status of the joint. The choice to avoid the use of bone grafts or substitutes did not affect the final outcome in term of loss of reduction in patients with good bone quality (Schatzker type II fractures: no statistically significant difference between post-surgery and final follow-up: $p = 0.514$). In older patients, in particular female, with poor bone quality (Schatzker type III fractures) we observed a statistically significant loss of reduction between post-surgery and final follow-up ($p = 0.038$), despite satisfactory clinical results.

LIGAMENTOTAXIS IN PILON-TIBIAL FRACTURES

M. Pigni

Azienda Istituto Ospedale Civile di Legnano (Legnano-IT), e-mail: mariopigni@tin.it

Introduction Tibial plafond fractures in the distal tibia result from axial forces that can range from low to high energy and produce a spectrum of articular and metaphyseal injuries. These can be challenging to manage, especially when associated with significant soft-

tissue injury [1]. Open reduction and internal fixation (ORIF) is the accepted method of treatment of the tibial plafond fractures. Using this method, despite the good outcomes, some Authors have reported complication rates: open procedures with the previous soft tissue injury, significantly increase the risk of skin complications [2].

Aim and Methods We report our experience about the treatment of 17 cases in 6 years (2001–2006), 6 of II type of Ruedi e Allgower classification, 11 of III type. 12 of them were open, 5 of II type of Gustilo, 7 of III type. The main aim of our study was to analyse the efficacy of distractors and external fixator in various forms using the principle of ligamentotaxis to achieve a high degree of functional and cosmetic results in these fractures: Hoffman fixator, XCaliber Articulated Ankle Fixator, XCaliber Periarticular Hybrid Fixator [3, 4].

Results Average time of union varied from 6 weeks to 18 weeks depending upon the bone involved. Commonest complication was pin tract infection ($n = 8$), while delayed union ($n = 3$) and malunion ($n = 1$) were also observed. Good range of motion at the involved joint was observed in majority of the cases. As per modified clinical scoring system of Green and O'Brien (1978) excellent to good results were seen in 74% cases and fair to poor results in 26% [5].

References

1. Bonivento G (1993) Experience with a periarticular attachment to the Dynamic Axial Fixator. *Int J Orthoped Trauma* 3(3):52–54
2. Pierannunzii L, De Bellis, D'imporzano M (2002) Il trattamento chirurgico delle Fratture del Pilon tibiale. *GIOT* 28:11–23
3. Maggi F, Lanzani E, Bastoni S, Valvason G (2006) Attuali orientamenti nel trattamento delle fratture del pilone tibiale. 91° Congresso Nazionale SIOT
4. Marsh JL, Lavini F. Distal tibial and pilon fractures. *Operative Technique. Orthofix Operative Technique Manual* n. 7
5. Michelson J. Fractures about the ankle. *JBJS Vol* 77-a

TREATMENT OF THE BICONDILAR TIBIAL FRACTURES: ROLE OF THE ANGULAR STABILITY PLATES

R. Spagnolo, D. Capitani, E. Marinoni, M. Bonalumi, F. Sala, F. Pace, L. Mazzoleni

Milan-IT

The complex proximal tibial plateau fractures need surgical treatment to achieve good clinical outcome. Treatment of this kind of fracture is often complicated by compromised general conditions of the patient or by the soft tissue. The necessity to grant a successful bone healing with the correct axes and the anatomical reduction of the articular surface, needs surgery with a stable synthesis to permit early mobilization.

We have treated the 41-C type fractures and the most common complications of this kind of fractures involve the surgical wound healing, loss of reduction and articular rigidity. To grant a successful healing of the soft tissues and to prevent the lost of vascularization of the fracture fragments many authors have introduced the concept of indirect reduction.

The angular stability plates combine the technical advantages of fixed-angle construct with biological plating technique, in fact this kind of plate permits the perfect stability of the system with angular stability screws and to make a minimal invasive surgery avoiding the opening of the fracture site, sliding it above shaft periostium through an incision at the level of the lateral plateau.

Between December 2002 and December 2006 we treated 40 patients of whom 25 affected by complex tibial plateau fracture; 22 patients have been treated with the LISS system and 3 with Perilocking plate. At the beginning it has been performed an artic-

ular synthesis with compression canulated screws or lag screws. It has never been necessary to use bone graft and we have almost always used bicortical screws. We have positioned a medial support plate in one case.

The post-operative care foresees early articular mobilization with CPM and no weight bearing until 8–12 weeks after surgery. We obtained the perfect radiological healing after an average of 71.2 weeks without no evidence of ROM deficiency, axial or rotatory deviation neither deep infection or compartmental syndrome. In 2 cases we found the breaking of the plate (13 hole LISS) and we substituted them with a DCP plate and an intramedullary nail.

Suggested readings

1. Schatzker J, Mc Broom R, Bruce D (1979) The tibial plateau fracture. The Toronto experience. *Clin Orthop* 138:94–104
2. Young MJ, Barrack RL (1994) Complications of internal fixation of tibial plateau fractures. *Orthop Rev* 23:149–154
3. Farouk O, Krettek C, Miclau T et al (1997) Minimally invasive plate osteosynthesis and vascularity: preliminary results of a cadaver injection study. *Injury* 28[Suppl 1]:A7–A12

TRANSARTICULAR REDUCTION AND PERCUTANEOUS OSTEOSYNTHESIS TARPO AND MINIMAL INVASIVE PERCUTANEOUS OSTEOSYNTHESIS MIPO WITH LOCKING AND COMPRESSION PLATE IN DIFFERENT PATTERNS OF PROXIMAL TIBIA FRACTURE: INDICATION AND RESULTS

F. Castelli, E. Marinoni, R. Spagnolo, D. Capitani

C.U. Orthopaedics and Traumatology, DEA Niguarda Ca' Granda (Milan-IT), e-mail: md.castelli@fastwebnet.it

Objective Fractures of the tibial plateau involve one of the major joint and require for good function joint congruity, axial alignment, stability of the joint a sufficient range of motion. Early motion must be instituted to prevent joint stiffness and help cartilage vitality. Indication for surgery must be guide by Schatzker's principles.

Methods and Results The review of patients was complete on 43 patients out of 52 treated with new locking plates. We had 27 male and 16 female with proximal tibial fractures. The average age was 46 years with a minimum of 24 years and a maximum of 89 years. The average follow-up was 29.8 months with a minimum of 14 months and a maximum of 51 months. We evaluated every patient with a subjective scale of quality of life (KSS). We reviewed radiographically the time of healing and measured the ROM for every patient. With an average follow-up of 29.8 months we checked the secondary displacement for every patient. The average time of healing was 13.2 months with a minimum of 9 and a maximum of 22 in a fracture Type 6 of Schatzker. The average ROM was 4° to 111° ($r = 0-13$) ($r = 86-150$). KKS score was excellent in 46% of cases, good in 37%, sufficient in 10% and poor in 7%. We thought that it was a good result comparing the complexity of pattern of fracture and the extremity of age fracture in our series. In our series the bad prognosis was related to soft tissue condition for high energy pattern of fractures, poor bone stock and highly comminution in elderly, perfect reconstruction of frontal axis, joint congruity, meniscal injury or grossly instability and associated ligament injury. We minimized the approach through TARPO technique (arthroscopically aided if necessary) to the joint and MIPO to the metaphysis in order to avoid additional soft tissue stripping, additional instability or source of joint stiffness.

Conclusions The locking plate offers sure advantages but does not allow the fracture to heal *per se*. The fracture often appears in different ways putting into difficulty also really expert trauma surgeons. The message that I want to leave from this personal

experience is that in order to avoid to get in worst prognosis in presence of difficult fractures, it is mandatory to the surgeon taking care of reading the pathoanatomy of the fracture, working with correct timing after having planned the reduction, the fixation method, the implant but also the function that the system will have to carry out in this particular pattern of fractures.

FAT EMBOLISM AND IM NAILING: WHEN AND HOW OF THE ORTHOPAEDIC TREATMENT

F. Castelli, F. Sala, R. Spagnolo, D. Capitani

C.U. Orthopaedics and Traumatology, DEA Niguarda Ca' Granda (Milan-IT), e-mail: md.castelli@fastwebnet.it

Objective Historically, the term "fat embolism" has often related to patients with fractures. The term fat embolism syndrome should be distinguished from acute fat embolism, which may occur during resuscitation and manual chest decompression, or during instrumentation of a shaft fracture. The occurrence of fat embolism in trauma patients has been estimated to be as high as 90%, although only 5% develop fat embolism syndrome [1]. In literature the incident of FES after femoral nailing is about 3–4% from different authors. Timing of the fracture fixation also appears to impact on the incident of FES. From several authors the optimal timing for femoral fixation is within 24 h.

Methods and Results In our experience at Niguarda Hospital we reported few cases of fat embolism syndrome in the last 5 years in special situation as a young and active patient on traction and bed rest for isolated high energy shaft femoral fracture or a case of FES after nailing in polytrauma patients with bilateral femoral fractures [2]. Using suction and irrigation with reaming it was possible to consistently produce negative pressure. AO have pursued the possibility of providing suction-irrigation reaming, resulting in the development of a one pass, reduced or negative pressure reaming system (RIA). Pape and Giannoudis, using the RIA in a lung-injured sheep model, compared the suction-irrigation reaming to a standard reamed or unreamed nailing. They reported pulmonary permeability that was significantly higher in the group treated with reamed femoral nailing than RIA, the stimulatory capacity of the polymorphonuclear leukocytes was better in those reamed with RIA and also D-dimer levels at four-hour post-operatively were significantly higher in the group treated with reamed femoral nailing than in the other two groups [3].

Conclusions The findings by Pape and Giannoudis indicate that the coagulopathic response due to systemic fat emboli may be reduced by the use of a modified reamer design that irrigates the canal and removes debris. This reaming method may be useful for minimizing systemic inflammatory effects of femoral nail placement; however, clinical validation of the RIA system is necessary to confirm that this effect also occurs in the clinical setting. Feasibility testing and a cost-effectiveness analysis must be performed before it can be recommended for routinely clinical practice.

References

1. Pinney SJ, Keating JF, Meek RM (1998) Fat embolism syndrome in isolated femoral fractures: does timing of nailing influence incidence? *Injury* 29(2):131–133
2. Giannoudis PV, Cohen A, Hinsche A et al (2000) Simultaneous bilateral femoral fractures: systemic complications in 14 cases. *Int Orthop* 24(5):2264–2267
3. Pape HC, Zelle B, Hildebrand F et al (2005) Reamed femoral nailing in sheep: does irrigation and aspiration of intramedullary contents alter the systemic response? *JBJS* 87A:2515–2522

UTILITY OF THE MEDIAL PLATE IN THE TREATMENT OF COMPLEX FRACTURES OF THE TIBIAL PLATEAU WITH LOCKING PLATES

M. Berlusconi, F. Chiodini, D. Marchettini, L. Di Mento, I. Scarabello

UO di Traumatologia II, Istituto Clinico Humanitas (Milan-IT)

Introduction The keys for the treatment of complex fractures of the tibial plateau are: (1) proper timing for the surgical procedure; (2) good technique and selection of the approaches; (3) use of adequate implants in order to obtain stability enough to allow an early mobilisation of the knee. The comminution of the joint surface, the involvement of both the tibial columns and the suffering of the soft tissues make the surgical procedure demanding and the results not as good as desired. In this study we present our experience in the treatment of these complex fractures with locking plates and try to define the importance of the use of a medial plate as a fundamental step in the reconstruction of the joint surface.

Material and Methods From January 2005 to January 2008 in our Department 25 patients with a complex fracture of the tibial plateau (C3 according to the AO-ASIF classification) have been treated by open reduction and internal fixation with locking plates (LCP - Synthes). All the patients have been followed-up clinically and radiographically until consolidation. Results have been defined on the basis of the time and rate of union, quality of reduction and ROM and function recovery compared to the preoperative status.

Results and Conclusions A good result in the treatment of these fractures is strongly influenced by four factors: (1) the respect of the soft tissue by a proper surgical timing: we suggest the use of a spurring ex fix as a temporary device to allow the healing of the soft tissues after the high energy of the trauma; (2) an accurate pre-operative planning that must take into consideration the importance of the medial column for the reconstruction of the joint surface: in our experience the medial reconstruction is the first and most important step in restoring the anatomy to the tibial plateau; (3) the use of plates with locking screws: the fixed angle of the screws act as a valid buttress for the joint surface; (4) the filling of the gap by bone grafting after bone disimpaction. In our experience a double approach technique with a medial and lateral plating has lead to good results in the treatment of complex (C3) fractures of the tibial plateau.

ANALYSIS OF INFLUENCE OF TIMING AND ANTICOAGULANT/ANTIPLATELET THERAPY ON RISK OF COMPLICATIONS IN PATIENTS AFFECTED BY PROXIMAL FEMORAL FRACTURE

F. Castoldi, F. Dettoni, N. Lollino, D. Blonna, S. Parisi, A. Marmotti, G.L. Collo, D.E. Bonasia, R. Rossi

Ospedale Mauriziano Umberto I, Università degli Studi di Torino (Turin-IT)

Introduction We evaluated the incidence of complications related to timing (time between admission and operation) and oral antiplatelet/anticoagulant therapy in patients treated for a hip fracture.

Material and Methods We prospectively evaluated 5 groups of 30 patients each, selected out of 875 consecutive patients admitted at the First Aid Unit of our Hospital with a proximal femoral fracture: group A - patients on Warfarin therapy, treated over 5 days after admission (in order to allow wash-out of Warfarin, as advised by many Anaesthesiologist Associations); group B - patients treated

over 5 days after admission, not on Warfarin therapy; group C - patients treated less than 48 hours after admission, not on Warfarin therapy; group D - patients on Aspirin/NSAIDs therapy, treated over 5 days after admission; group E - patients on Ticlopidine/Clopidogrel therapy, treated over 5 days after admission. The groups were comparable regarding age, gender, pre-trauma walking ability, mental state, fracture type and treatment. Blood loss, number of RBC transfusions, complications during hospitalization and up to 6 months after discharge, length of hospitalization, degree of functional recovery and 2 years mortality were recorded. Statistical analysis included Kruskal-Wallis, U-Mann-Whitney and Logistic Regression Tests (SPSS 13.0 software).

Results Group A showed higher preoperative blood loss ($p = 0.002$), and longer hospitalization ($p < 0.001$), compared to all other groups. Groups D and E showed no higher complication and mortality rate in comparison to group B and C, while group A showed higher complication and mortality rate. Standing alone, timing and Warfarin appear not to be significant risk factors, while taken together they represent a high risk factor for complications and mortality ($p = 0.009$).

Discussion and Conclusions Patients on Warfarin therapy, affected by hip fracture, are at high risk of complications and mortality, if the recommendation of postponing treatment until drug wash-out is accepted. Reversal of anticoagulation using vitamin K and straight-forward treatment should be considered. Antiplatelet therapy appears not to have the same adverse effect as anticoagulant therapy.

EPIDEMIOLOGICAL SURVEY ON RISK FACTORS FOR HIP FRACTURES: INDACO PROJECT

G. Iolascon¹, P. Bartolozzi², L. Del Sasso³, A. Faldini⁴, G. Guida¹

¹Dipartimento di Scienze Ortopediche, Traumatologiche, Riabilitative e Plastico-Ricostruttive, Seconda Università di Napoli (Napoli-IT); ²Dipartimento di Chirurgia Ortopedica, Università degli Studi di Verona (Verona-IT); ³Divisione di Ortopedia e Traumatologia, Azienda Ospedaliera S. Anna (Como-IT); ⁴Bologna-IT

Given the increasing importance of the morbidity and mortality associated with hip fractures, it is fundamental to identify screening methods in order to prevent them appropriately. Optimal identification of high-risk individuals would be a simple questionnaire assessing easy-to-know information on patients, linked to hip fracture risk.

The FRACTURE index is a model with and without BMD T-scores, identifying variables that could be easily assessed in either clinical practice or by self-administration. This model was developed and validated by Dennis Black, Olof Johnell and others in 2001, and it is a good and simple tool for the screening of risk factors among patients in the orthopaedics clinical practice allowing (even without BMD direct assessment) important insights about patient 5-years probability of hip fracture occurrence (every 2 units of FRACTURE index there is about a two fold increase of 5-yrs hip fracture probability).

The assessment tool, is a set of seven key parameters that can be easily asked to a patient within the usual orthopedic practice: these parameters include age, BMD T-score, fracture after age 50 years, maternal hip fracture after age 50, weight less than or equal to 57 kg, smoking status, and use of arms to stand up from a chair.

In this epidemiological survey (called INDACO – Indagine Centri Ortopedia), conducted by the Italian Society of Orthopedics and Traumatology (SIOT) we evaluated the FRACTURE index among over 6000 patients recruited in 150 Italian Orthopedics centres.

Among the overall patients recruited, about 3000 had a recent hip fracture. The objective of the survey is to confirm the validity of FRACTURE score index assessment in a clinical setting and to compare the fracture risk probability among patients with or without a recent hip fracture. The survey started in January 2008 and will last until June 2008, allowing preliminary results to be shared at the time of the Congress.

TRAUMATOLOGY 4

PROXIMAL HUMERAL FRACTURES: “EPIBLOC” SYSTEM

M. Papalia, L. Lucente, M. Papalia

Nuova ITOR (Rome-IT)

The majority of proximal humerus fractures are treated nonoperatively with good functional results. Multiple options exist for treating displaced fractures, without a clear advantage of any one method for a given fracture type. Goals include an adequate reduction and stable fixation to initiate early motion and rehabilitation. Decision-making should be based on patient and injury specifics and surgeon's experience. Various types of fixation, including plates, nails, percutaneous pins, or emiarthroplasty can maintain sufficient stability to promote shoulder mobility and function. Any of these methods will have few complications when undertaken with appropriate patient selection and careful surgical technique. We present our experience with a minimally invasive percutaneous osteosynthesis system, the Epibloc, with a personal modification of surgical technique. The Epibloc is a simple and safe technique to obtain a stable fixation of fractures preserving vascular supply of proximal humeral head.

DIAPHYSEAL FOREARM FRACTURES: CORRELATION BETWEEN CLINICAL-RADIOGRAPHIC AND PROGNOSTIC EVALUATION

G. Pilato, A. Bini, M.F. Surace, A. Vicario, N. Migliavacca, P. Cherubino

Clinica Ortopedica (Varese-IT)

The open reduction and osteosynthesis with plating systems is a widely accepted treatment in literature of diaphyseal forearm fractures. The correction of the length, angular and rotational translation and of the interosseous space of the radius and ulna has always been of high interest amongst all authors related to the identification and resolution of the fractures problematic and treatment. (Pecorelli et al., 1985; Ross et al., 1989; Anderson et al., 1975; Gaudenti, 1989; Schemitsch et al., 1992).

Aim of this study was to evaluate the results and verify the efficacy in solving the problems related to the fracture treatment and its safety. Furthermore it has been possible to relate the clinical and radiographic results with the prognostic factors to enlighten the effect of controllable and uncontrollable treatment variables.

Between 1991 and 2006, 100 patients underwent surgery, of these 83 have a main follow-up of 87 months (range 9–144). The fractures were studied with preoperative standard X-ray and with the AO classification. The exposition of the fracture if present was evaluated with the Gustilo-Anderson classification. The obtained stability of the osteosynthesis, studied with postoperative X-ray, was evaluated with the Ross classification (1989).

During the follow-up each patient was evaluated with the clinical and anamnestic exam (mainly evaluating intensity and kind of pain),

the measurement of the strength was performed with Jamar dynamometer and radiographic study with standard projections. It has been considered the time elapsed for the sport and job resumption and the patient's satisfaction. The results were classified according to Anderson's criteria's enounced in 1975.

Fracture consolidation was gained in 71 cases (86%) in a mean time of 3.3 months (range 2–6 months). Twelve (14%) fractures ended in pseudoarthrosis. These fractures needed a further surgical treatment. Seventy patients expressed full satisfaction (84%), while 30 (36%) resulted to be without any symptoms. The results according to the Anderson classification, where considered excellent in 48 cases (58%), satisfactory in 13 cases (10%) and unsuccessful in 12 cases (14%). Altogether the results considered good were of 61 cases (76%). In patients treated with 1/3 tubular plating systems on both skeletal segments the percentage of good results fell to 60%. The functional and radiographic results demonstrated a statistical significant correlation ($p < 0.5$) considering the following factors: patients age when the trauma occurred, fracture type, exposition, osteosynthesis stability and plaster immobilization. In our experience we obtained clinical good results in 76% of the patients, this percentage appears to be lower than in other literature results (72–92%). Even the fracture consolidation obtained in the 86% on the patients is lower than in literature studies presented by other authors.

A lower percentage surely finds an explanation in the fact that our case study is homogeneous because did not include proximal and distal fractures and furthermore the poor results are due to the beginning period in the first years of the nineties when 1/3 tubular plates were still used; in fact excluding from our study all the patients treated with 1/3 tubular plates, that did not guarantee in an high number of cases a stable synthesis and that were used in the past, the percentage of consolidations rise from the 86% to the 91.5% and the clinical results considered good rise from the 76% to the 90%. From the study of the prognostic factors emerged how the anatomical reduction and the stable synthesis guarantee optimal results, but influence able by non-surgeons dependant variables like the age of the patient, the complexity of the fractures and the exposition.

MIPO OF THE HUMERAL SHAFT FRACTURE. REVIEW OF THE LITERATURE: LATERAL APPROACH VERSUS ANTERIOR APPROACH

R. Spagnolo¹, D. Capitani¹, M. Bonalumi¹, M. Miranda¹, F. Pace², L. Mazzoleni²

¹Divisione di Orto-Traumatologia, Ospedale Niguarda Ca' Granda (Milan-IT); ²Scuola di Specializzazione in Ortopedia e Traumatologia, Università degli Studi di Milano (Milan-IT)

The treatment of humeral shaft fractures has always been a very debated topic; both conservative and surgical treatment offer advantages and disadvantages. Conservative methods are not well tolerated and in the long period could give shoulder and elbow rigidity. The surgical treatment gives the great advantages of a stable fixation and early mobilization but it needs an extended approach with the consequent soft tissue damage and devascularization of the fracture fragments.

Minimally Invasive Plate Osteosynthesis (MIPO) has lately gained popularity, with satisfactory clinical outcomes in the treatment of long bone fractures using the plate by the bridging fixation technique. Percutaneous plate insertion in humeral shaft fractures seems to be a dangerous procedure as far as the risk of radial nerve injury is concerned.

The surgical technique ideated by the first two authors provide a lateral approach and is based on the identification of three major

cutaneous windows: the first one is performed 5 cm from the acromion and a splitting of the deltoid muscle is performed to the bone; the second one, at the level of the middle third, allows to control the sliding of the plate between the biceps and triceps muscles and to obtain reduction; the third one, at the distal level, is necessary to isolate and protect the radial nerve. We always used 4.5 mm LCP plates for the distal metaphysis inverting its position proximal to distal to exploit the low profile of the plate and the reduced plate to bone contact to avoid periosteal devascularization. The plate is inserted through the proximal window and it is slid between muscles and periosteum and locked with angular stability screws. When necessary the compression of the fracture is obtained through the second window. According to AO classification we treated 12 A1 A2 A3, 12 B1, B3 and 13 C1 C2 C3 type fractures and in association with 11 A1 A2 A3. In this paper we will review the results of this MIPO technique in 24 patients and the literature. In our patients no cases of post-operative lesions to radial and circumflex nerve, neither infection, pseudoarthrosis or plate mobilization are reported. Comparing our approach to the anterior one, it's important to underline that with the lateral approach the circumflex nerve is vulnerable and it's necessary to compress the plate to the bone to avoid any damage and afterwards the plate is made slid laterally so that the plate couldn't interfere with the long biceps tendon. Another aspect is that in case of radial nerve palsy with our approach is not necessary to make another incision because we isolate it anytime.

FREE VASCULARIZED FIBULAR GRAFT IN THE TREATMENT OF CHRONIC OSTEOMYELITIS OF FOREARM

P. Tos, L.G. Conforti, A. Bernardi, B. Battiston

U.O.D. Reconstructive Microsurgery, I Divisione Ortopedica, Ospedale CTO, Azienda Ospedaliera CTO-CRF-ICORMA (Turin-IT), e-mail: pierluigi.tos@unito.it

Introduction For decades the treatment of chronic posttraumatic osteomyelitis associated with bone exposure has been one of the most serious problems in the field of orthopedic surgery. "Sterilization" of the osteomyelitic site, that is radical debridement of all infected tissue, is the basic requirement of the treatment. Type IV osteomyelitis sec Cirney-Mader impose bone resection. The reconstruction with conventional graft exposes to bone resorption or osteomyelitis recurrence. Vascularized bone graft gives a more healing chance.

Aim of the study We followed-up 9 cases of chronic posttraumatic osteomyelitis of forearm treated with vascularized fibular graft of the forearm.

Material and Methods Nine patients treated between 1992 and 2004 (6 radius, 3 ulna) by means of free fibula vascularized bone graft are followed-up (mean 3 years min-max 2–4 years). Functional and radiological evaluation has been performed with the Tang System. In 8 cases a two-stage treatment was performed (resection and sterilization, eventually with muscle transfer, in the first stage and free bone transfer in the second one); only in 1 case a one-stage treatment was performed (posttraumatic loss of substance). Two cases required a composite tissue transfer with a skin pad to cover the exposure. Almost all patients had been more than 3 previous surgical attempt with conventional treatment (sterilization and bone graft). The length of bone defect after extensive resection of necrotic bone from septic pseudoarthrosis ranged from 5–14 cm (mean 9). Stabilisation was obtained by means of plates and screws in all cases.

Results In all cases the infection was never recurred. The mean period to obtain radiographic bone union was 4.0 months (range,

2.5–6 months). In 2 cases a secondary procedures have been done due to an aseptic non union in one site of graft (cruentation and compression plate). Functional results were always satisfactory but never a complete range of motion has been achieved (plurioperated patients with DRUJ problems).

Conclusions and Discussion Fibular grafts allow the use of a segment of diaphyseal bone which is structurally similar to the radius and ulna; the length it's sufficient to reconstruct most skeletal defects. The vascularized fibular graft is indicated in patients where conventional bone grafting has failed or large bone defects, exceeding 5 cm, are observed. The application of microsurgical fibular transfers for reconstruction of the extremities allows repair of bone and soft-tissue defects when shortening is not indicated with good functional results and allows one-stage repair. No donor site morbidity has been detected.

Suggested readings

1. Adani R, Delcroix L, Innocenti M, Marcoccio I, Tarallo L, Celli A, Ceruso M (2004) Reconstruction of large posttraumatic skeletal defects of the forearm by vascularized free fibular graft. *Microsurgery* 24(6):423–429
2. Safoury Y (2005) Free vascularized fibula for the treatment of traumatic bone defects and nonunion of the forearm bones. *J Hand Surg [Br]* 30(1):67–72
3. Dell PC, Sheppard JE (1984) Vascularized bone grafts in the treatment of infected forearm nonunions. *J Hand Surg [Am]* 9(5):653–658

LOCKED HUMERAL NAIL WITH MECHANICAL TARGETING

M. Manca, M. Palomba, M. Iacopinelli

UOC Ortopedia e Traumatologia, Ospedale Versilia, AUSL 12 (Viareggio-Lucca-IT)

Introduction Fractures of the humeral diaphysis are relatively frequent representing 1–3% of all fractures [1]. Functional bracing with rare pseudoarthrosis and well tolerate malunion is still a valid treatment option. Amongst surgical treatment options intramedullary nailing may represent the golden standard [1]. According to the literature no difference has been reported in functional outcome after healing in antegrade or retrograde nailing. Retrograde nailing is technically more demanding than antegrade nailing. Fractures or fissures at the insertion point occur in retrograde nailing [2, 3]. Pseudoarthrosis is reported amongst the most relevant complications in order of importance (5.9%) [2]. Good fracture reduction and stable fixation should be obtained [2]. Locking requires at least two screws both at proximal and distal level [1]. It is known that locking of two or more screws at the tip of the nail is rather difficult [2]. The humeral Centronail offers the possibility of guided mechanical locking. This allows increased stability and should lead to a reduced percentage of pseudoarthrosis.

Material and Methods Twenty patients with diaphyseal humeral fractures have been treated between May 2007 and March 2008. 13 male and 7 female patients, age range between 24 e 78 years. According to the AO fracture classification: 9 fractures were type 12 A, 7 were type 12 B and 4 were type 12 C. Antegrade nailing in 13 cases and retrograde in 7. Braces and slings were not indicated. All patients followed a rehabilitation protocol.

Results In all cases mechanical targeting allowed locking of 4 or 5 screws of which 2 or 3 at the tip of the nail. All fractures healed but in one case loosening of the proximal screws led to reoperation. In one case neuropraxia of the radial nerve resolved spontaneously. One case reported a 10° limitation of extension of the elbow. One case reported pain in elevation, abduction and extrarotation due to nail protrusion.

Discussion and Conclusions The Centronail system allows stable fixation with at least four locking screws and always at least two screws at the tip of the nail. The mechanical targeting allows locking of the screws with little radiation exposure for the surgeon and the patient. We consider stable nailing of humeral fractures the reason for the reduced incidence of pseudoarthrosis.

References

1. Maniscalco P et al (2006) Aggiornamento Club Italiano Ost 12:49–54
2. Blum J, Janzing H, Gahr R et al (2001) Clinical performance of a new medullary humeral nail: antegrade versus retrograde insertion. *J Orthop Trauma* 15(5):342–349
3. Lin J et al (1998) *Clin Orthop* 365:201–210

MASSIVE BONE GRAFTS AND BONE RE-CONSTRUCTION IN UPPER LIMB COMPLEX FRACTURES

P. Palombi, F. Rodia, A. Ventura, M. Lillo, A. Piccioli

II UO Ortopedia, C.T.O. “A. Alesini”, ASL RMC (Rome-IT)

The aim of the treatment of bone non-unions is the curettage of the non-union site and a new fixation, in order to set the optimal bio-mechanical setting for bone healing. In some circumstances, bone curettage leads to a segmental deficit that needs to be filled. For such cases, bone grafting can be used, both by auto and by allograft or by synthetic substitutes of bone or of its demineralised matrix, each of one with its selective indications. Apart from grafting, it is now possible to use synthetic cytochines addressed to promoting bone formation, namely the Bone Morphogenetic Proteins (BMPs). Among them, two are to be used in orthopaedic field, BMP 2 and BMP 7. These proteins promote osteoinduction, leading undifferentiated mesenchymal cells to osteo and chondrogenic cells; these proteins amplify and optimize osteoconduction of bone grafts when they are used as scaffold to recover normal bone morphology. BMP 7 is moreover indicated for use as an alternative to the patient's own bone (autograft) in recalcitrant long bone non-unions where autograft is unfeasible and alternative treatments have failed.

Aim of the present study is the retrospective analysis of the use of allograft bone grafts along with BMP 7 in the treatment of long bone non-unions with a segmental deficit that could not be filled by a new fixation, e therefore larger, in our series, than 1.8 cm.

All the treated cases have gained bone healing in an average time of 2.3 months from revision surgery and, although our study is limited for number and case specificity, it has to be considered as a positive result.

THE TREATMENT OF SUBCUTANEOUS ACHILLES TENDON INJURIES WITH MINI-INVASIVE TECHNIQUE (TENOLIG®): CASE REVIEW

G. Manfredini, E. Tripoli, G. Campochiaro, E. Guidi, M.T. Donini, A. Canali

Division of Orthopaedics and Traumatology, Azienda Ospedaliero-Universitaria Policlinico di Modena (Modena-IT)

Subcutaneous Achilles tendon ruptures are injuries whose incidence is increasing (representing 35% of all injuries tendon). The injury is most common in males, aged between 30 and 50 years, practicing sport at amateur level. Diagnosis is clinical-anamnestic and it is supported in some cases by instrumental researches which ultrasound or MRI. Many authors have shown how the mini-invasive surgery is the gold standard as it offers fewer complications and good results. We have reviewed 35 operated cases of subcuta-

neous Achilles tendon injury treated from July 2005 to August 2007 with Tenolig. Patients were reviewed with a mean follow-up of 24 months (min. 13, max 39) and operated patients were 29 male and 6 female with an average age of 43 years (min. 32, max. 61). The clinical evaluation was performed following the parameters of the tab AOFAS. The loss of strength, endurance and power of each patient was determined by dynamometer REV 7000 techno Gym and in all patients was conducted a following study MRI.

The final results showed an average rate loss in pure strength of 11.6%, in power of 2.1% and in resistance of 4.7%. The sports recovery occurred in 20 of 35 patients, while 9 patients have not taken the previous sporting activity and the remaining 6 patients did not practice sports before the trauma. The circumference of the calf was equal to contralateral in 16 cases of examined patients, 12 cases had a slight ipotrofia (1–2 cm), 6 cases had an average ipotrofia (2–3.5 cm) and only one case had a serious ipotrofia (> 3.5 cm). Sural neuropathy does not occur and AOFAS final average score was 93 points with a minimum of 85 and a maximum of 100.

In conclusion we can say that the results of cases of acute subcutaneous Achilles tendon rupture treated with Tenolig are completely satisfying in 97% of cases (34 of 35 patients) in terms of functional and muscular recovery, allowing the resumption of regular sporting activity in 57% of cases. Only in one patient occurred a re-rupture 55 days after the treatment following a small trauma, which has forced the patient to a surgical resumption “open”. This failure is probably attributable to a traumatic mechanism. The Tenolig has a high cost (1073.28 euro) which may be partially written off by a minor hospitalization time, by the reduction of possible complications and an early resumption to work.

PERCUTANEOUS PIN OSTEOSYNTHESIS. BIOMECHANICAL STUDY ON PERCUTANEOUS PINS PULLOUT STRENGTH: A NEW PIN FOR A NEW STRENGTH

D. Blonna¹, F. Dettoni¹, M. Assom¹, R. Rossi¹, D. Bonasia¹, C. Bignardi², F. Castoldi¹

¹Ospedale Mauriziano Umberto I (Turin-IT); ²Dipartimento di Meccanica, Politecnico di Torino (Turin-IT)

Introduction Pins (K-wires) are used for a wide variety of purposes in Orthopaedic Surgery. In some cases the pin has to sustain traction forces along its axis (e.g.: fixation of long bones metaphyseal fracture): strength originates from grip of the extremity of the pin within the bone (pullout strength). The design of the pin's extremity is fundamental for this purpose: a pin with a smooth end has a lower pullout strength than one with a threaded tip. The most commonly used pins are: (1) smooth ended, (2) terminally (2–3 cm) threaded pins. In our clinical practice we introduced pins of 2.5 mm diameter, with a 70-mm threaded extremity, stabilized by tightening the pins one to another with an external fixator-like device, thus allowing a bicortical grip and a certain angular stability. The purpose of our study was to verify the biomechanical characteristics of this new pin fixation system.

Material and Methods We performed pullout tests on different pins in synthetic epoxy composite bones. We then created different configurations of couples of pin (parallel, or angulated at different degrees), and, after fixing the pins one to another, performed a pullout test. We used 2.5-mm pins: A-smooth; B-25-mm threaded; C-70-mm threaded. The epoxy composite bones we used were Sawbones Biomechanical Test Short-Fiber-Filled Epoxy Cylinders #3403-19 (diameter: 40 mm, cortex: 2 mm). Tests were performed using a MTS Q-test 10 Elite press, measuring the pullout strength (N), at a 1 mm/s speed.

Results Results are reported in Tables 1 and 2.

Table 1 Pullout strength, single pin (N)

	2 cortices	1 cortex	2 cort. + osteolysis	1 cort. + osteolysis
Smooth pins	86	37	115	36
25-mm threaded pins	663	225	757	152
70-mm threaded pins	938	440	605	95

Table 2 Pullout strength, two pins, fixed (N)

2 pins, fixed, bicortical grip					
Configuration	Parallel	20°	30°	40°	
25-mm threaded pins	1391	895	1099	1222	
70-mm threaded pins	2145	1660	1832	1836	
2 pins, fixed, monocortical grip					
Configuration		20°	30°	40°	
25-mm threaded pins		351	693	862	
70-mm threaded pins		1186	1518	1248	

Discussion and Conclusions The data we collected on the 70-mm threaded pin confirmed our hypothesis that this pin offers a higher resistance to pullout forces, with a strength up to 10-fold smooth pins, and twice partially threaded pins. By stabilizing pins fixing them with an ex-fix like device, pullout strength raises, as demonstrated by the second part of the study. The use in clinical practice of this newly designed pin and stabilization device can be a significant improvement in Orthopaedic Surgery, thus allowing extending the indication for pin fixation also to fracture patterns that were once considered too much unstable for this treatment.

FRACTURE REPAIR IN ELDERLY: RATE OF REVISION

S. Scarponi, R. Scarponi

Department of Orthopaedic Surgery, Policlinico Santa Rita (Milan-IT)

Objective Fracture-repair is a complex biological process to restore skeletal integrity by regeneration bone, whereas the failure can lead to devastating clinical consequences. The greatest challenge in performing clinical research is identifying clinically relevant and quantifiable end-points. This study can provide information relevant to medical and surgical communities as meet regulatory requirements. The end-points must provide the hypothesis to formulate, whether these findings are negative results. This will be important to increase investigation of expensive technologies, to better care for patient with fractures.

Patients and Methods To develop a better understanding of the patients with fractures and having more information in order to plan the treatment and predict the outcomes, we need to answer the following questions: what are the comorbidity medical conditions (diabetes, obesity, older age, smoking, and infection), physical factors? Which fractures heal more predictably? Is it really possible to accelerate the healing of normal fractures and can we enhance it with stem-cells, molecules, scaffolds treatment? Between December 2006 and December 2007, in our Institute, 240 patients were operated for fractures of the proximal part of the femur. From these patients we obtained the following information: the prevalence and the demographic of fractures that showed delayed or failed healing.

Results This study is based on 240 patients operated for fractures of the proximal part of the femur. The mean age was 83.9 years.

The prevalent sex was female. Eight patients had had mechanical failures at short-term: 4 cut-off screws and neck varitation; 2 endoprosthesis dislocations, 2 superficial infections. These infections were sustained by *Pseudomonas*. Two patients after revisions died. Other 4 patients died by the first three months.

Discussion How do fix the Pertrochanteric fractures? In the 1975–2000 period compression hip-screws sliding was the gold-standard device. In the 1980s the single screw nail device, due to the large geometry of the trochanteric area. No outcome difference between nail device and plate-screw devices. The failures are: higher rate of cutting-out, the rate of delayed union, and rate of varus angulation. Cut-out failure related to axial load and rotation? Cephalomedullary nail-TFN-A SYNTHES: are they better?

Conclusions This study confirms that frailty and severity, as indicated by advanced age, and comorbidity are significant predictors of worse outcomes. The nature of our data showed the risk of adverse events related to the experience of the surgeons, type of device, experience room staff type.

INTERNAL CORTICAL FIXATION (OCI) WITH LOCKING AND POLYAXIAL PLATES (NCB)

F. Biggi, F. Carnielli, S. Di Fabio, S. Trevisani

UOA di Ortopedia e Traumatologia, Ospedale San Martino (Belluno-IT)

Internal Cortical Fixation is becoming very popular thanks to new technological improvements, able to reduce the main complications related to the conventional plate and nail systems: impairment of repairing osteogenesis (particularly the periosteal one), low adaptability to the bone morphology, excessive rigidity in comparison with bone elastic modulus, mechanical failures regarding both plates and nails, and intolerance due to the poor manufacturing. Main indications, for open or closed reduction and internal fixation, are articular and periarticular fractures of upper and lower limb, where anatomical reduction is mandatory, primary stability essential to allow the sequence of repairing osteogenesis and early mobilization imperative for functional recovery.

The NCB (Non Contact Bridging) plates represent the natural evolution of perlocking plates, and have all the characteristics to be considered a last generation device: anatomical pre-contoured design matching the shape of different articular districts; titanium alloy structure that means enough rigidity and elasticity to support fracture site and bone remodelling; angular stability between plate and screws, obtained with a locked “self-screwing” mechanism; poliaxiality intend as the opportunity of inserting the screws with 30° of angulations in different planes; dedicated instrumentation for conventional surgery or MIPO (Minimally Invasive Percutaneous Osteosynthesis).

Our experience started on January 2006, with 136 cases treated until December 2007: we evaluated all cases on the base of clinical and radiographic records. Bone healing and articular reconstruction was obtained in 87% of patients, while 13% had complications in terms of plate and screws breakage (3%), delayed union (5%), skin problems (3%) and infections (2%).

ORAL PRESENTATIONS

FOOT AND ANKLE

A REABSORBABLE SPACER FOR THE FIRST METATARSO-PHALANGEAL JOINT IN THE SURGICAL TREATMENT OF HALLUX RIGIDUS

B. Magnan, E. Samaila, G. Viola, P. Bartolozzi

Orthopaedic Department, University of Verona (Verona-IT)

Implantation of metatarso-phalangeal prostheses or spacers has been widely indicated for the replacement of the articular surfaces in severe hallux rigidus. A reabsorbable spacer in poly(D-L-lactic acid) (PDLLA) which is dome-shaped with a stem for implantation into the first metatarsal, has been proposed avoiding any resection of the base of the proximal phalanx. The rationale of the reabsorbable spacer is to maintain the distance between the articular surfaces and provide a sliding surface suitable for articulation. It is then reabsorbed and replaced by fibrous tissue, which allows motion and removes pain.

Twenty-four reabsorbable spacers have been inserted for severe hallux rigidus in 20 patients aged from 26 and 76 years (average 58). Patients were reviewed with a follow-up ranging between 24 and 72 months (average 50). The results were assessed using the American Orthopaedic Foot and Ankle Society (A.O.F.A.S.), hallux-metatarsophalangeal-interphalangeal scale. Anteroposterior and lateral weight-bearing X-ray were made preoperatively and at follow-up, evaluating the dimensions of the articular space and the length of the first metatarsal.

The chronology of device reabsorption was studied in 10 patients with M.R.I., assessing complete reabsorption within 4 months of the operation. Excellent and good results were obtained in 91.6% of patients. The A.O.F.A.S. score was 43.7 ± 20.6 pre-operatively and 80.1 ± 24.7 at the follow-up.

The reabsorbable spacer confirmed the expectations of its protagonists. This procedure would appear to be an alternative to arthrodesis of the first metatarso-phalangeal joint or traditional permanent implants, and represents an intermediate technique between an implant and resection arthroplasty.

ARTHROSCOPIC THERMAL SHRINKAGE TO TREAT CHRONIC LATERAL ANKLE INSTABILITY: MID-TERM RESULTS

M. Maiotti, C. Massoni

Sports Medicine Center, "San Giovanni-Addolorata-Calvary" Hospital (Rome-IT)

Objective Chronic lateral ankle instability represents an unpleasant complication of sport related ankle sprain. In this study we evaluate the mid-term results of arthroscopic thermal capsular shrinkage [1, 2] performed to treat chronic lateral ankle instability in soccer players.

Material and Methods We reviewed 58 male soccer players (average age: 23 years) with chronic lateral ankle instability who underwent arthroscopic thermal shrinkage between 1999 and 2003. Exclusion criteria for this study were the failure of previous surgery or functional ankle instability. All the patients enrolled in this study had attended a

physical rehabilitation program for several months, without any relief of their symptoms. All patients were characterized by repeated episodes of "giving way", a positive anterior drawer sign and positive stress radiographs. The stress radiographs consisted of a sagittal stress and talar tilt by TELOS. The American Orthopaedic Foot and Ankle Society Ankle/Hindfoot score was used to assess these patients for their current activity level as well as activity before surgery.

Results The average follow-up was 74 months (range 60 to 96 months); fifty patients (86.2%) reported a good or excellent functional outcome as assessed by the AOFAS Ankle/Hindfoot score and forty-two patients (72.4%) showed no evidence of ankle instability on stress radiographs. Only eight patients (13.7%) were not able to return to their previous sport activity level but not complained of either pain or any other discomfort in day living activities.

Conclusions The outcomes of our series demonstrated that arthroscopic thermal capsular shrinkage is a valid and safe procedure for treatment of chronic lateral ankle instability with satisfactory mid-term results even in high-demand athletes.

Level of evidence Level IV, therapeutic case series.

References

1. Hyer CF, Vancourt R (2004) Arthroscopic repair of lateral ankle instability by using the thermal-assisted capsular shift procedure: a review of 4 cases. *J Foot Ankle Surg* 43(2):104–109
2. Maiotti M, Massoni C, Tarantino U (2005) The use of arthroscopic thermal shrinkage to treat chronic lateral ankle instability in young athletes. *Arthroscopy* 21(6):751–757

SURGICAL TREATMENT OF OSTEOCHONDRAL LESIONS OF THE TALUS (OLT)

R. Buda, F. Vannini, R. Ghermandi, A. Ruffilli, S. Giannini

Department of Orthopaedic Surgery, Rizzoli Orthopaedic Institute, University of Bologna (Bologna-IT)

Objective Osteochondral lesions of the talus (OLT) are a frequent cause of pain and functional impairment due to poor reparative capability of the cartilage. The purpose of this study is to present guidelines for treatment of OLT based on a review of 172 cases.

Material and Methods 172 patients (mean age 33 ± 12 years) were treated between 1996 and 2007. Before surgery, all patients were evaluated clinically by AOFAS score, radiographically, and by MRI to characterize the lesion. Surgical treatment was carried out according classification of lesions proposed by the Authors. Acute lesions were either debrided (15 cases) or fixed (6 cases). 52 OLT $< 1.5 \text{ cm}^2$, were treated arthroscopically by debridement and microfractures of the lesion. 94 OLT $> 1.5 \text{ cm}^2$ were treated by open (9 cases), arthroscopic (46 cases) Autologous Chondrocyte Implantation (ACI) and Bone Marrow Derived Cells (BMDCs) Transplantation (39 cases). And extensive poor shoulder lesions were treated by using an osteochondral graft (5 cases). 7 patients treated by ACI (3 cases) or BMDCs Transplantation (4 cases) underwent a second arthroscopy with a biptic cartilage harvest at 1 year follow-up. Samples were stained with Safranin-O and Alcian Blue. Immunohistochemical analysis for collagen type II was also performed. All patients were checked clinically and by MRI up to 6 years mean follow-up (1 year–12 years).

Results Mean AOFAS score before surgery was 52 ± 14 . At 12 months it was 88.5 ± 12 and 92.8 ± 12 ($p < 0.0005$) at 6 years mean follow-up. Histological and immunohistochemical analyses showed

typical cartilage morphology and were positive for collagen type II and proteoglycans expression. No radiographic signs of arthritis were observed at 6-year follow-up. MRI showed well-modeled restoration of the articular surface.

Conclusions In conclusion, OLT are a challenging pathology. Only after careful choice of surgical technique, while considering pathoanatomy and labelling factors, optimal and minimally-invasive results can be achieved. Microfractures resulted as an effective technique to improve pain and function in OLT < 1.5 cm²; ACI, performed by open technique or arthroscopically provided excellent results for OLT > 1.5 cm² at follow-up. BMDCs Transplantation was proposed as an evolution of cartilage repair for OLT > 1.5 cm² and, although shorter follow-up, proved to be an effective technique able to obtain results similar to ACI. Furthermore, the overcoming of ACI drawbacks obtained with BMDCs Transplantation may permit to extend the application of hyaline repair procedure even to lesions of smaller size.

ANKLE ALLOGRAFT RECONSTRUCTIONS

S. Giannini, R. Buda, F. Vannini, R. Bevoni, F. Di Caprio

Clinica Ortopedica, Università di Bologna (Bologna-IT)

Introduction Post traumatic arthritis of the ankle in young patients is an important therapeutic challenge. Ankle arthrodesis gives good results in terms of control of pain but produces functional impairment and it is difficult to accept by a young person. Considering failures of prosthetic surgery in young patients, the new therapeutic trends are biologic osteochondral allografts. Fresh osteochondral allografts would provide viable cartilage that can survive transplantation and bone that would provide an intact structure until host bone replaces it. The purpose of this study is to describe the preliminary results of a series of 36 bipolar shell ankle allografts performed by using a specifically designed instrumentation.

Methods 36 patients (mean age 32 ± 11 years) affected by post traumatic arthritis of the unilateral ankle joint grade III received bipolar shell allograft of the ankle. The ideal patient to allograft match was permitted through CT scan and X-ray. Patients' evaluation was carried out clinically by AOFAS and radiographically by X-ray, CT scans, MRI.

Results The mean follow-up was 30 months (range 8–32). A medial malleolar fracture occurred as an intraoperative complication. All the patients demonstrated good consolidation rates of the allograft at X-ray, CT scan and MRI controls at a mean time of 5 months. After 6 months, complete weight-bearing was allowed. Excellent or good results were obtained in 22 patients. Among the 5 bad results, one was revised, 2 underwent ankle arthrodesis, the others are still waiting for surgery. A bioptic harvest of the transplanted cartilage in all patients at 1 year follow up demonstrated chondrocytes vitality > 90%.

Discussion Fresh total shell osteochondral allograft of the ankle, although technically demanding, is a viable alternative to arthrodesis or arthroplasty in individuals with advanced ankle arthritis. Nonetheless further studies are needed to confirm the efficacy of this technique.

TRAUMATOLOGY

PROTOCOL-DRIVEN APPROACH OF BLEEDING ABDOMINAL AND PELVIC TRAUMA

F. Castelli¹, F. Sala¹, R. Spagnolo¹, U. Valentinotti¹, A. La Maida¹, O. Chiara², D. Capitani¹

¹C.U. Orthopaedics and Traumatology, DEA Niguarda Ca' Granda (Milan-IT), e-mail: md.castelli@fastwebnet.it; ²Trauma Team, DEA Niguarda Ca' Granda (Milan-IT)

Objective Control on a priority basis of predominant site of haemorrhage in multitrauma patients with pelvic disruption may be critical for survival. Purpose of this study was to evaluate prospectively a work-up based on initial pelvic radiograph, abdominal ultrasound (US) and contrast CT (CESCT).

Methods Eighty-seven multi trauma bleeding patients with pelvic fracture were included. Patients were separated in two groups: group A with unstable fractures and increased pelvic volume and group B with stable fractures or unstable fractures but decreased pelvic volume. Group A patients received temporary pelvic volume closure measures. Positive US triggered emergency celiotomy and CESCT selected angiographic embolization (AE) or external fixation (EF) for retroperitoneal bleeding. Predominant site of bleeding, need of celiotomy, AE or EF and mortality were compared in two groups.

Results Pelvic haemorrhage was the main source of bleeding in 87% of group A and 6% of group B ($p < 0.001$). CESCT demonstrated arterial bleeding amenable to AE in 57% patients with pelvic haemorrhage. No differences in the need for celiotomy and mortality were observed between two groups.

Conclusions Pattern of pelvic fracture may be suggestive of the predominant site of bleeding. CESCT is useful to choose appropriate treatment in case of pelvic bleeding.

Table 1 Classification of pelvic fractures as determined by Orthopaedic Surgeons from pelvis antero-posterior plain radiograph. Tile classification is based on the biomechanical stability of the pelvic ring (Tile class A: stable, B: rotationally unstable, C: totally unstable) while Young & Burgess classify injuries with regard to the direction of disrupting force (APC antero-posterior compression, LC lateral compression, VS vertical shear). For the purposes of this study fracture patterns have been differentiated in two groups

Fracture pattern	Description
1	Biomechanically stable Tile A, direction of force not significant. All pelvic fractures without ligament disruption or pelvic volume modification.
2	Biomechanically rotationally unstable Tile B1, Y-B antero-posterior compression. Progressive ligament disruption and increased pelvic volume.
3	Biomechanically bilateral rotationally unstable Tile B3, Y-B antero-posterior compression. Progressive ligament disruption with association of anterior and posterior fracture of pelvic ring and with pelvic volume increase.
4	Biomechanically rotationally unstable Tile B2, Y-B lateral compression. Pelvic fracture without ligament disruption and with decreased pelvic volume.
5	Biomechanical totally unstable Tile C1, Y-B vertical shear. Pelvic fracture/dislocation with complete ligament disruption and with pelvic volume increase.
6	Biomechanical bilateral totally unstable Tile C2-C3, Y-B vertical shear. Pelvic bilateral fracture/dislocation with complete ligament disruption and with pelvic volume increase.
7	Any type of isolated acetabular fracture.

Group A patterns ($n = 37$): 2 ($n = 13$), 3 ($n = 7$), 5 ($n = 7$), 6 ($n = 10$); Group B patterns ($n = 50$): 1 ($n = 21$), 4 ($n = 13$), 7 ($n = 16$)

LAST GENERATION INTRAMEDULLARY NAILING SYSTEM

F. Biggi, C. D'Antimo, S. Di Fabio, T. Pagliara

UOA di Ortopedia e Traumatologia, Ospedale San Martino (Belluno-IT)

Reamed locked intramedullary nailing is the current gold standard for femoral and tibial diaphyseal fractures: early reduction and stabilization, utilizing closed technique, allow better recovery and results in terms of bone healing and function. We can identify three different nail generations: first was the Kuntscher's nail [1], second the Grosse-Kempf locking nail [2], and third, the last one, the Anatomical Locking Nail, more conforming in terms of medullary canal fitting, and closer to the bone elastic modulus because the titanium alloy manufacturing [3].

The anatomical intramedullary locking nail system that we have utilized in the last 3 years is the SIRUS (Zimmer srl), which allows the treatment of femoral and tibial fractures, with extension to proximal and distal metaphyseal area, independently by the degree of comminution and number of fragments because the multiple locking screw fixation in different planes.

Surgical technique, for both femoral and tibial nails, is based on closed reduction over fracture's table under image intensifier control, minimally invasive approach and bone perforation, reaming, nail insertion over guide-wire, multiplanar proximal and distal locking.

In the period between January 2005 and December 2007 we treated with SIRUS nail 42 femoral and 69 tibial fractures, 64 men and 47 women, age between 16 and 87 years. According to AO classification, we identified for the femoral side 19 type 32-A, 13 32-B, and 10 type 32-C; for the tibial side 33 type 42-A, 26 type 42-B and 10 type 42-C. About 50% of cases were classified as high-energy trauma, and 15% were grade I-II open fractures.

Bone healing was obtained in 3–5 months for femur and in 3–6 months for tibia. As complication we identified 4 screw breakage, 2 in femur and 2 in tibia.

In conclusion, the SIRUS Anatomical Locking Nail System provides a safe and accurate treatment for both femoral and tibial fractures. Technique and instruments are able to allow a reproducible result for trauma surgeons facing this type of injuries.

References

1. Kuntscher G (1943) Über die marknagelung unter besonderer berücksichtigung der kriegschirurgie. *Zbl F Chir* 47
2. Kempf I, Grosse A, Beck G (1985) Closed locked intramedullary nailing: first application to comminuted fractures of the femur. *J Bone Joint Surg* 67A:709–716
3. Court-Brown C, McQueen M, Tornetta P (2006) Intramedullary nailing. In: *Trauma*, Lippincott Williams & Wilkins, Philadelphia, pp 440–445

DOCET XT: A NEW NAIL FOR THE PERTROCHANTERIC FRACTURES

C. Velluti, C. Chelo, M. Verona

Clinica Ortopedica, University of Cagliari, Marino Hospital, Lungomare Poetto (Cagliari-IT), e-mail: velluti@tiscali.it / clchelo@tiscali.it

Introduction The Docet XT (Fig. 1) is a new generation nail for pertrochanteric fractures of the femur. The characteristic is a proximal fixation with a double pin to avoid the spin of the femoral neck (Fig. 1) and a double distal stabilizer extracted from the inside of the nail for dynamic stability (Fig. 2). The advantages of this nail

are an easy surgical technique, reduction of surgical time, minimal exposure time on X-ray, no distal incision, no femoral head rotation during follow-up, and no cut-out. The aim of this study is to evalu-

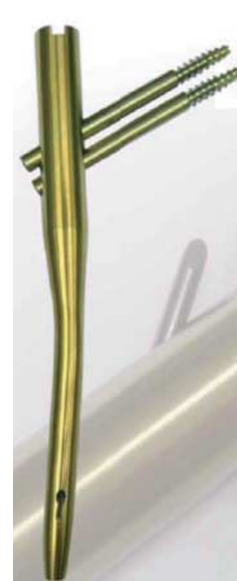


Fig. 1 The Docet XT

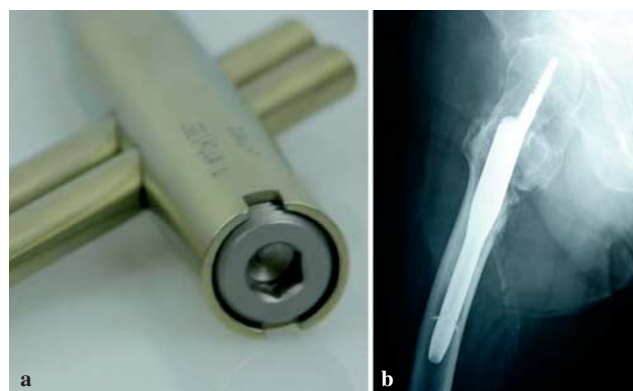


Fig. 2a Mechanism for the extraction of the stabilizers; **b** The stabilizers put in the bone



Fig. 3a Pre-operative; **b** Post-operative

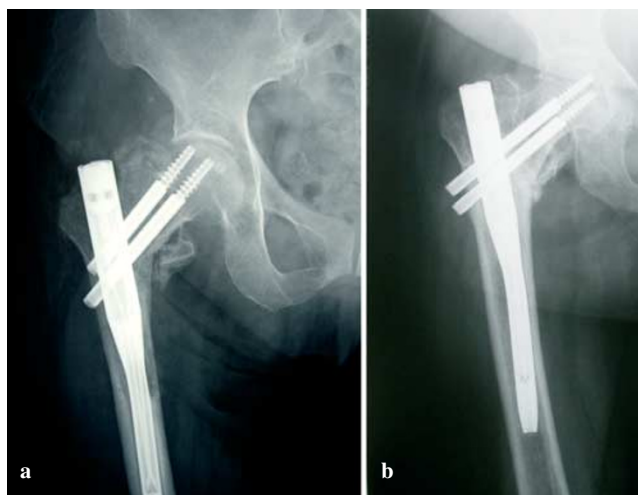


Fig. 4a Follow-up: 3 months; **b** Follow-up: 9 months

ate the management of pertrochanteric fractures of the femur using this nail.

Material and Methods 103 consecutive patients who had suffered a pertrochanteric, intertrochanteric or high subtrochanteric fracture, or a combination of fractures were treated by closed reduction internal fixation by Docet XT nail from May 2007 to May 2008 (Figs. 3 and 4)

Results Our preliminary results indicate a surgical time 30 min (min 15, max 50), X-ray exposition 10.3 s (min 10.0, max 40.0), the Failed distal locking ($n = 0$), superior cut-out of lag screw ($n = 0$) and postoperative varus malreduction ($n = 1$).

Conclusions Docet XT nail is a suitable implant for management of pertrochanteric fractures of the femur.

A NEW ENDOMEDULLARY NAIL FOR PROXIMAL HUMERUS FRACTURES, THANKS TO THE PARTNERSHIP OF ITALIAN UNIVERSITY HOSPITAL AND INDUSTRY RESEARCH

U. Tarantino, G. Cannata

Department of Orthopaedics and Traumatology, University Hospital Policlinico Tor Vergata (Rome-IT)

We developed a new endomedullary nail for osteosynthesis of proximal humerus fractures, hand in hand with Citieffe from Calderara di Reno (Bologna). Relying upon our previous experience with similar implants, for which we had already assessed qualities, restraints and flaws, we aimed at overcoming problems concerning the hold of the implant also in bad quality bones, easily adapting the implant to various types of fracture, and simplifying the operation technique while enhancing accuracy and minimizing invasivity of the operation at the same time.

“Dinamic T Omero” titanium nail is cannulated, anatomic, and provided with holes for five proximal screws, with a retention system that reduces the risks of screw pull-out without seizing. The first three screws, facing the joint surface, are fan-type directed on different planes and are threaded for a spongy bone; similarly threaded is a fourth screw sagittally directed. The fifth screw of the proximal group is directed in such a way to compact the humeral head on the “medial hinge”. Both static and dynamic locking can be made distally. All the screws are provided with a head that attaches firmly to the proper screwdriver, reducing the risks of wrong directions and preventing the loss of the screws in surgical paths.

The screw head is also threaded externally, to achieve better hold and low-profile implant. A nail cap is available in three lengths, which besides protecting the attachment of the upper end of the nail for extraction, allows inserting it to the depth required in each single case: it also attaches to the screwdriver, therefore it is impossible to loose it in soft tissues, or even worse, in the humeral head while screwing. Before inserting the three cephalic fan-type directed screws, three “phantom” wires are inserted through the nail, which enable the surgeon to evaluate in advance the final positioning of the screws and their hold, using fluoroscopy also in axillary and continuous views. The external guide allows inserting additional screws tangent to the nail to synthesize loosen fragments of trochitis (“out-nail” screws): this system is compatible with the Rondò cannulated screws which include a constrained and tilting washer. The insertion system facilitates the correct positioning of the guide wire while minimizing dissection of soft tissues.

Our preliminary experience with Dinamic T Omero nail, about to be widened by a multi-center evaluation, has confirmed the validity of our premises and the successful achievement of the predetermined targets.

FEATURES OF A MODERN EXTERNAL FIXATION SYSTEM

B. Pavolini, R. Passalacqua

ASL1 di Massa e Carrara (Massa Carrara-IT)

External fixator CITIEFFE F4 is the synthesis of the experience acquired in 25 years of use of previous fixator ST.A.R. 90. The fundamental concepts behind fixator ST.A.R. 90 project are practicalness of use and versatility, both aimed at maximizing the effectiveness of treatment; the main characteristics of the system were: a pre-assembled body capable to make micrometrical reduction movements and axial sliding movements for callus dynamization, freedom of choice concerning the point of pin insertion and the possibility of positioning them on different planes, and varied kit accessories.

Over the years, due to the demand of increasingly improved performances, a remarkable potential for improvement of this range of products has been found and developed, which has resulted in the design of fixator F4. This fixator maintains the positive features of fixator ST.A.R.90 enhancing significantly both performances and possible applications, thus proposing a real fixation “system”, profitably usable in most traumatic pictures as well as in conventional preferred indications.

The main attributes of this system can be summed up as follows: (1) versatility in assembly, which means being capable of performing a monolateral assembly with a reduced number of fiches as well as complex three-dimensional assemblies to cope in facts with any traumatic pictures; (2) a simple system, which includes a limited number of basic components, usable in all assemblies, and allows adding further components only when necessary, providing a gradual learning curve; (3) the possibility of making a series of corrections to optimize treatment; in particular it is possible to perform the rotary correction of the segment treated.

Authors explain the critical and industrial process that originated from fixator ST.A.R. 90 to develop and introduce fixator F4, pointing out, in particular, the interaction between clinical and engineering aspects and the invention of those components enabling surgeons to overcome some particular traumatic conditions.

EXTERNAL FIXATION FOR INTRA-ARTICULAR DISPLACED CALCANEAL FRACTURES

B. Magnan, E. Samaila, G. Viola, P. Bartolozzi

Orthopaedic Department, University of Verona (Verona-IT)

Introduction A minimally invasive procedure including percutaneous reduction and external fixation can be performed for Sanders' type II, III and IV heel fractures in order to obtain a tridimensional reconstruction of the os calcis with a reduced risk of local complications, allowing for early motion.

Methods Fifty-four consecutive closed articular displaced calcaneal fractures in 52 patients were treated with the Orthofix Heel Mini-Fixator. Patients were followed for an average of 49 months (range, 27 to 94 months) and assessed clinically with the Maryland Foot Score and radiographically with X-ray and CT scans.

Results Clinical results at follow-up scored excellent or good in 49/54 cases (90.7%), fair in 2 cases (3.7%) and bad in 3 cases (5.6%). Mean preoperative Böehler's angle was $6.98^\circ \pm 12.93$ (range, 5.95–19.86), while after surgery the average value was $21.94^\circ \pm 9.36$ (range, 12.58–31.30) ($p < 0.01$). C.T. scans were evaluated according to the S.A.V.E. score, showing excellent results in 24 cases (44.4%), good results in 25 cases (46.3%), fair results in 3 cases (5.6%) and bad results in 2 cases (3.7%). Mean preoperative S.A.V.E. score was 17.58 ± 4.98 (range, 12.60–22.56) while the postoperative score was 25.66 ± 2.44 (range, 23.22 – 28.1) ($p < 0.01$). Complications: Sudeck's atrophy ($n = 10$), pin tract superficial infections ($n = 3$), thalamic displacement following early weight-bearing ($n = 3$).

Conclusions Percutaneous reduction and external fixation proved to be a reliable technique in order for obtaining stable reduction of os calcis fractures. The clinical results appear to be comparable to those obtainable with the open reduction and internal fixation, with the added advantages of being minimally invasive procedure, having substantially shorter operating times and reducing risk of complications related to surgical exposure.

“THE DELTA SYNTHESIS” AN ORIGINAL PERCUTANEOUS TECHNIQUE IN ASAIII-ASAIV PATIENTS

M. Tangari

Department of Traumatology, “S. John Hospital” (Rome-IT)

Introduction The field of application in the approach to the supracondylar fractures of the femur, humerus and distal tibia has focused on the plate and on the antegrade and retrograde intramedullary nailing. These techniques have shown some problems such as the open air accesses on the plates, the loss of the periosteum of the fragments in the plafond area (not highly vascularized in itself), the necessity of reaming in the antegrade nails and the articular opening into the retrograde nails.

Description The versatility of Miros System, made up of steel wires, fiches and clips of stabilisation, allows a lot of combinations between external and internal synthesis (hybrid synthesis). In the supracondylar fractures of femur and humerus applying a transversal transcondylar wire, and anchoring to it intramedullary wires



Fig. 1

through two lateral clips, it can be obtained a stable synthesis that, because of its form, is called “Delta”.

Material and Methods Fifteen patients were treated with Delta Synthesis (six fractures of the distal tibia, five supracondylar of humerus and four of femur); all patients were elderly and classified as ASAIII and IV and thus with high risk for intervention.

Discussion In the Delta Synthesis three steel wires form a high apex triangle structure, where the intramedullary wires are called “oblique terminal”, and the horizontal wire is the “horizontal terminal”; a sort of reticular steel framework, inserted in the surrounding bone; an arch, with the higher resistance in case of compression or torsion. During the deambulation the oblique terminals' flexion can be seen, with the tension of the transversal terminal and subsequent epiphysis' mass traction. This rhythmic compression of the fracture, the so-called “pumping effect”, is the apex of the structural efficiency of the system, since it accelerates the fracture recovery, and happens in a quick time.

Results All patients had a convenient nursing; a rapid functional recovery and healing.

Conclusions The Miros System has a multifunctional fixation system that permits the construction of hybrid synthesis such as the Delta Synthesis, that extends the indication in extreme area like the elbow, femur and distal tibia fractures. This new technique is shown to be simple in execution, minimally aggressive and quite steady, so as to allow not only the maintenance of the anatomy but also a rapid functional recovery of the patients.

ORAL COMMUNICATIONS

KNEE AND SPORTS TRAUMATOLOGY

DOUBLE BUNDLE ACL RECONSTRUCTION: A CAOS STUDY

E. Monaco, L. Labianca, B. Maestri, A. De Carli, F. Conteduca, A. Ferretti

Orthopaedic Unit and "Kirk Kilgour" Sports Injury Center, S. Andrea Hospital, "La Sapienza" University of Rome (Rome-IT)

Objective Single bundle ACL reconstruction, as evaluated in cadaveric studies, seems to be insufficient to control a combined rotator load of internal and valgus torque. On the contrary anatomic double bundles reconstruction of ACL might produce a better biomechanical outcome, especially during rotator loads. The hypothesis of the present study is that the addition of the PL bundle to the AM bundle, in an *in vivo* double bundle computer assisted ACL reconstruction, is able to reduce the internal rotation of the tibia at different degrees of flexion.

Material and Methods Ten consecutive ACL reconstruction procedures were performed in males using double bundle gracilis and semitendinosus tendons graft with the 2.0 OrthoPilot ACL navigation system (B. Braun-Aesculap, Tuttlingen, Germany). Anteroposterior displacement at 30°, 60° and 90° as well as internal and external rotation at 0°, 15°, 30°, 45°, 60°, 90° of knee flexion were evaluated before reconstruction, after fixation of the antero-medial (AM) bundle and than after fixation of the postero-lateral (PL) bundle (AM+PL).

Results Fixation of the AM bundle reduces significantly ($p < 0.05$) the antero-posterior displacement at 30° and 90° of knee flexion, while the addition of the PL bundle does not produce a further significant reduction ($p > 0.05$). The addition of the PL bundle to the AM bundle does not reduce significantly internal and external rotation of the tibia at all degrees of flexion ($p > 0.05$).

Discussion On the basis of this study, the hypothesis that the addition of the PL bundle to the AM bundle is able to reduce the internal rotation of the tibia minimizing the pivot-shift phenomenon is not confirmed.

Conclusions The effective role of the anatomic double bundle procedure in better restoring the knee kinematic, allowing better clinical outcomes, should be questioned in an *in vivo* model.

THE EFFECT OF ACCELERATED, BRACE FREE, REHABILITATION ON BONE TUNNEL ENLARGEMENT AFTER ACL RECONSTRUCTION USING HAMSTRING TENDONS: A CT STUDY

A. Vadalà, R. Iorio, A. De Carli, G. Argento, V. Di Sanzo, F. Conteduca, A. Ferretti

Orthopaedic Department, S. Andrea Hospital, "La Sapienza" University of Rome (Rome-IT)

Background The mechanism of bone tunnel enlargement following anterior cruciate ligament (ACL) reconstruction is not yet clearly understood. Many authors hypothesized that aggressive rehabilitation protocols may be a potential factor for tunnel enlargement, especially in reconstructions performed with hamstrings autograft. The purpose of this study was to evaluate the effect of a brace free rehabilitation on the tunnel enlargement after ACL reconstruction using doubled semitendinosus and gracilis tendons: our hypothesis

was that early post operative knee motion increases the diameters of the tibial and femoral bone tunnels.

Material and Methods Forty-five consecutive patients undergoing ACL reconstruction for chronic ACL deficiency were selected. All patients were operated by the same surgeon using autologous doubled semitendinosus and gracilis tendons and the same fixation devices. Patients with associated ligaments injuries and or severe chondral damage were excluded. The patients were randomly assigned to enter the control group (group A, standard post operative rehabilitation) and the study group (group B, brace free accelerated rehabilitation). A CT scan was used to exactly determine the diameters of both femoral and tibial tunnels at various levels of lateral femoral condyle and proximal tibia, using a previously described method. Measurements were done by an independent radiologist in a blinded fashion the day after the operation and at a mean follow-up of ten months (range 9–11). Statistical analysis was performed using paired *t*-test.

Results The mean femoral tunnel diameter increased significantly from 9.04 ± 0.05 mm (post-op) to 9.30 ± 0.8 mm (follow-up) in group A and from 9.04 ± 0.03 mm to 9.94 ± 1.12 mm in group B. The mean tibial tunnel diameter increased significantly from 9.03 ± 0.04 mm to 10.01 ± 0.80 mm in group A and from 9.04 ± 0.03 mm to 10.60 ± 0.78 mm in group B. The increase in femoral and tunnel diameters observed in the study group was significantly higher than that observed in the control group.

Conclusions Our results suggest that bone tunnels enlargement after ACL reconstruction using hamstrings autograft can be increased by an accelerated, brace free, rehabilitation protocol.

THE USE OF PLATELET GROWING FACTORS IN THE TREATMENT OF CHRONIC ACHILLEUS TENDONITIS

E. Diotti, M. Lovato, C. Manzini

Ospedale "Borella" (Giussano-IT)

Objective The chronic tendinitis of the achilleus tendon is the most frequent of overuse syndrome of the lower limb.

Material and Methods We have used the GPF (platelet growing factors) for the treatment of this pathology to improve the inflammation, the pain and to have quicker return to sports activities. Platelet concentrate produced by the GPS® II system is derived from the patient's own blood. This technology uses a centrifuge to separate out the patients own blood components by their various densities. The red blood cells (RBCs) are denser and will move to the bottom. The plasma fraction is the least dense and will float on the top layer. The "buffy coat" which contains the majority of platelets will be sandwiched between the plasma and above the RBCs. Platelets contain various growth factors (also called cytokines): platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), insulin like growth factor (IGF), and vascular endothelial growth factor (VEGF). Platelet concentrate is obtained by the process of spinning down the patient's own blood and collecting the buffy coat which contains the concentrated platelets and white blood cells. We have applied this system on 30 young sports men with chronic achilleus tendonitis. The GPF are injected in local anesthesia after some scarification performed by needle.

Conclusions the results are very encouraging.

PCL RECONSTRUCTION: A NEW ARTHROSCOPIC TECHNIQUE

F. Margheritini, F. Modonesi, F. Frascari

Rome-IT

Purpose Many operative techniques have been described for reconstructing the posterior cruciate ligament (PCL) but so far none has been able to consistently correct abnormal posterior laxity or provide consistent functional results. So far the most used technique is the trans-tibial popularized by Clancy in the early '80s and implemented later with the use of arthroscopy. While most of the attentions have been pointed at the tibial side, recently some studies have showed that the weak point of the graft is located on the femoral articular emergence rather than the tibial one. The aim of this paper is to present a new arthroscopic technique combining the advantages of the arthroscopic approach with those of the inlay fixation on the femur footprint in order to produce better biomechanical and anatomical reconstruction.

Surgical technique Patient's set-up is similar to a standard trans-tibial arthroscopic reconstruction. Ipsilateral quadriceps tendon-bone grafts is harvested, creating patellar bone plug approximately of 15 mm long by 12 mm wide by 8 mm deep, and incorporating all 3 layers of the quadriceps tendon, as suggested by Noyes. The bone block is first fashioned to obtain a circular plug measuring 1 cm of diameter and 8 mm in depth, then drilled and prepared to accept a cannulated 3 mm screw. Tibial tunnel is first created, after placing two posterior portals and working using a transeptal view. Then the femoral attachment is debride trying to preserve as much as possible of the native posterior cruciate ligament Using a PCL femoral guide (Acufex, Smith and Nephew, Andover, Massachusetts) a 2.3 mm pin is inserted using an outside-in procedure. Then a femoral socket of the some 10 mm depth is created so that the bone plug can fit in and then fixed with a cannulated screw (OsteoMed, Addison, TX).

Results After some cadaver studies performed at the Department of Anatomy of the University of Barcelona, four patients have been treated with this technique from June 2006 to February 2007. Two out of four were complaining with a PCL rupture with a posterolateral grade I lesion, the others two presented an isolated PCL lesion. The average posterior translation at the time of surgery was 11.4 ± 1.7 mm, while they showed an average translation of 3.2 ± 0.8 mm at an average of 10 months post-op.

Conclusions The femoral inlay arthroscopic reconstruction has been proposed to reduce the biomechanical effects of the femoral sharp angle on the graft fibres and to provide a more anatomical reconstruction. Early results are satisfactory and encourage in further biomechanical and clinical studies.

Suggested readings

1. Handy MH, Blessey PB, Kline AJ, Miller MD (2005) The graft/tunnel angles in posterior cruciate ligament reconstruction: a cadaver comparison of two techniques for femoral tunnel placement. *Arthroscopy* 21(6):711–714
2. Margheritini F, Mauro CS, Rihn JA, Stabile KJ, Woo SL, Harner CD (2004) Biomechanical comparison of tibial inlay versus transtibial techniques for posterior cruciate ligament reconstruction: analysis of knee kinematics and graft in situ forces. *Am J Sports Med* 32(3):587–593

A PROSPECTIVE MRI AND CT COMPARISON OF TWO DIFFERENT BIOABSORBABLE ANTERIOR CRUCIATE LIGAMENT INTERFERENCE SCREWS WITHIN THE FIRST YEAR AFTER IMPLANTATION

F. Margheritini, G.B. Minio Paluello, F. Frascari, F.R. Ripani, P. Mariani

IUSM-University of Movement Sciences (Rome-IT); Santo Spirito in Sassia Hospital (Rome-IT); "La Sapienza" University (Rome-IT)

Purpose The overall clinical results of bioabsorbable fixation devices made of poly-L-lactic acid (PLLA) used for cruciate ligaments reconstruction have been favourable. However, clinical stud-

ies demonstrated no sign of normal bony architecture restored after surgery, although implant channels had been filled with fibrous tissue. The purpose of this prospective study was to examine the extent of structural changes in two different types of bioabsorbable devices using magnetic resonance imaging (MRI) and CT scan over one year period.

Material and Methods The study group consisted of 20 patients with isolated anterior cruciate ligament ruptures reconstructed with bone-patellar tendon-bone autografts fixed with two different types of bioabsorbable screw: a poly-L-lactic acid/hydroxyapatite blend (PLLA + HA) interference screw (BioRCI®, Smith & Nephew Endoscopy, Andover, MA) or screw A and a blend of poly (DL lactide-co-glycolide) (PDLG) and calcium carbonate screw (Calaxo®, Smith & Nephew Endoscopy) or screw B. For each surgery the screw position was alternated in order to obtain the same number of screws equally placed either in the femur or in the tibia. All patients were operated by the same surgeon using a single incision technique with an autologous ipsilateral bone patellar tendon bone graft. Femoral screw was inserted via anteromedial portal. All patients followed the same similar aggressive rehabilitation protocol with a 6 months return to pivoting sports. Post-op X-ray were obtained immediately after the surgery, while a complete MRI study was performed at 2, 4 and 12 months post-op. The later evaluation included a CT scan as well. The screw degradation, the bone block formation and new bone formation were evaluated using the classification scheme of Tecklenburg and Drogset. Clinical examination was achieved according to the IKDC form at the longest follow-up.

Results Both composite screws showed signs of degradation at MRI with the screw B almost disappeared within four months post-operatively while the screws merging in group A still clearly visible up to 12 months post-op. The CT scan performed at the longest follow-up, confirmed the calcium carbonate screw disappearance but failed to show any bony replacement within the reabsorbed area. Clinical examination showed all out of one A results according to the IKDC, the only B results was related to a patient who presented a large chondral damage on the lateral femoral condyle, who underwent at the time of surgery a microfracture technique.

Conclusions According to the data presented, the Calaxo screw was shown to be reabsorbed within few weeks from surgery however we failed to see instrumental presence of bone replacing within the area initially occupied by the screw, in an otherwise clinical unremarkable conditions.

MEDIAL REEFING IN PATELLO-FEMORAL INSTABILITY

A. Schiavone Panni, M. Tartarone, S. Cerciello, M. Vasso, C. Mazzotta, D. Santaiti

Department of Science for Health, University of Molise (Campobasso-IT)

Patello-femoral pathogenesis knowledge has improved in the past decades, thus its treatment has changed. Conservative approach was generally accepted even in case of multiple dislocations. The evidence of persistent symptoms and the high re-dislocation rate has led to a more aggressive attitude. More than 130 surgical procedures have been proposed in the last years in the treatment of patello-femoral instability. Recently, the role of the medial retinaculum and the medial patello-femoral ligament has been widely investigated and their stabilizing action has been stressed. Medial reefing has been proposed as a surgical treatment in patients with unstable patella that have failed a period of 3 to 6 months of conservative period. Although several surgical options have been described, varying from mini open to all inside techniques, we pre-

fer an all arthroscopic technique and we perform this reefing with three n. 1 PDS stitches. From April 2001 to April 2007 we performed 36 arthroscopic medial reefing procedures in patients with unstable painful patella. All patients were preoperatively evaluated with Kujala, Larsen, Tegner and Fulkerson scores. Moreover a complete imaging analysis (X-ray films and CT scans) confirmed the absence of bony anomalies. At the last FU (9 to 81 months) 30 patients were reviewed for both clinical and X-ray examination. Average Kujala score improved from 72.7 to 97.6, average Larsen score from 14.7 to 18.8, average Tegner from 65.3 to 97.7 and average Fulkerson score from 69.5 to 97.0.

Our clinical results are encouraging with high satisfaction rates and no recurrence of instability. Even if longer follow-up studies are necessary to confirm this mid term results, we believe that the key point relies in the strict indication. This procedure should be proposed in patients with unstable patella; we believe that in case of dislocation this is not a good option as it not addressed to the medial patello-femoral ligament lesion and a high recurrence rate may be expected. Moreover in case of severe anomalies of patellar instability predisposing factors more aggressive procedures should be considered.

NEUROSENSORIAL RESULTS OF ACL RECONSTRUCTION IN ATHLETES: THE KINESTHETIC APPROACH AFTER 14 YEARS OF CLINICAL EXPERIENCE

C. Corradini, D. Schipani, M. Zanotta, P. Parravicini, V. Colantonio, C. Verdoia

Orthopaedic and Traumatologic Clinic, Research Centre on Sports Trauma, University of Milan c/o 1st Division of Orthopaedics, G. Pini Institute (Milan-IT)

Purpose The purpose of this study was to resume the kinesthetic approach in the proprioceptive deficit of ACL injury and post-operative recovery after 14 years of clinical experience as an example of satisfactory application of researches and technologies to the progress of orthopaedic surgery.

Material and Methods More than one thousand athletes of both sex between 16–62 years (mean 32.6) affected by ACL injury diagnosed with MRI and verified arthroscopically were retrospectively considered. All patients underwent ACL reconstruction with free bone patellar tendon bone or gracilis and semitendinosus tendons autograft in arthroscopy by the same equipe. In few cases the association of meniscal tears or cartilage lesion requested a specific procedure; these cases were collected in different groups. A homogeneous group of athletes without history of knee injury was considered as control group. Through a computerized device the kinaesthetic data were collected after maintenance of stance in three positions, bipodalic and two monopodalic on healthy and injured or operated lower limb. A fourth exercise consisting in a description of double circle on the same platform was used to detect the functional stability. Every patient performed a minimum of four tests in each position. A mathematical algorithm was used for a qualitative assessment of somatosensory modifications.

Results Performance during the test shows a significant improvement between pre and post-operative values. At the second post-operative month the difference is already significant. This trend continues in each month till 6th month. At this month the functional stability is not statistically different in confront of the control group. Some difference may remain in ACL lesions associated to meniscal tear and /or other starting preoperative conditions related to the age, the time from injury and the rehabilitation postinjury. On monopodalic tests any significant difference was observed preoperatively and after surgery between the healthy side and the

injured or operated one. The improvement for an athlete in the first five years is constant while in the second five a worsening may happen related to the withdrawal from agonism. After the tenth year a physiologic somatosensory deterioration occurs in particular for forties. The advances of surgical techniques have permitted to reduce the time of immobilization and the percentage of painful syndrome.

Conclusions In the modern ACL surgery the development of the techniques and materials for the best recovery of functional stability cannot exclude a precise instrumental evaluation of neurosensorial deficits, as revealed by the kinesthetic approach.

KNEE CHONDRAL DEFECTS: 12-MONTH SECOND-LOOK ARTHROSCOPY AND CLINICAL FOLLOW-UP OF SYNTHETIC SCAFFOLD RESURFACING

F.V. Sciarretta, P. Versari, A. Basile, A. Ruvo, E. Di Cave

Ospedale Israelitico di Roma (Rome-IT)

Aim This study has been brought on in order to determine if synthetic resorbable scaffolds may provide a suitable, one single step treatment for degree III-IV chondral and osteochondral symptomatic defects of the knee.

Material and Methods For this study 73 consecutive patients (58 women, 15 men) who underwent implantation of synthetic reabsorbable scaffolds, of various diameters, composed of poly (DL-lactide-co-glycolide) have been enrolled. Average age at time of surgery was 53 years (range 27–65 years). Of these, 13 patients underwent second-look arthroscopy at one year in order to determine integration of the plugs, fill of the defects and quality of tissue formation.

Results The International Knee Documentation Committee (IKDC) and WOMAC forms have been used to evaluate clinical and functional outcomes. The IKDC evaluation showed a progressive improvement during the first twelve months, showing a 38 points increase at one year. WOMAC scores showed 89% improvement of pain and 86% improvement of function. Patients have also been controlled by serial knee MRI's that have shown progressive integration of bone plugs in absence of adverse reactions. Second-look arthroscopies showed complete filling and resurfacing of the defects with hyaline-like cartilage.

Conclusions Synthetic reabsorbable scaffold resurfacing provides an effective means to treat chondral and osteochondral defects of the knee less than 2.5 square centimeters in size in adult active patients. Patients experience an immediate pain relief and functional recovery, being quickly able to move back to previous daily and sport activities. These preliminary results highlight the need for further controlled studies currently underway.

ALGORITHM PROPOSAL FOR SURGICAL TREATMENT OF FOCAL KNEE CHONDRAL DEFECT IN ADULT

A. Scarchilli, L. Del Ferraro

6^a Divisione, Istituto Chirurgico Ortopedico Traumatologico (Latina-IT)

Aim The purpose of this study is to attempt a purpose of algorithm for the treatment of knee focal chondral defects. Many new surgical procedures and techniques have been developed recently in repair of IV (Outerbridge's classification) degree chondral defects. But before establishing therapeutics procedures it is mandatory to implement an algorithm of diagnostic and right indication for surgery treatment.

Methods Our treatment algorithm in > 30- and < 55-year-old is based on: (1) general conditions of patient (obesity, fumer, etc.); (2) anatomy evaluation: axis, ligamentous instability; (3) post-traumatic-iatrogenic damage; (4) location: femoral condyle, tibial plateau, patello-femoral; (5) local problems: quality and sub-condral bone, actions associates. Minimal invasive and tissue sparing surgery is preferred to preserve the intact or less severe damage of articular cartilage. In the last 3 years according to cases we utilized: (1) implantation of autologous chondrocytes one stage or two stages; (2) osteocondral biologicals cylinders; (3) HemiCAP® implantation.

Results We will illustrate our results from the clinical point of view (using the IKDC schedule and the Knee Score) and from Imaging (MNR, CT and X-Ray).

Conclusions Others techniques such as debridments, drilling, microfracture and abrasion-chondroplasty have been shown to result in fibrocartilage with inferior mechanical properties when compared with hyaline cartilage. This algorithm treatment is based on experience with no long-term follow-up and without randomized studies, but the results are encouraging and could aid the complex dilemma of reparation and treatment of sever chondral knee's defect.

ARTHROSCOPIC SECOND GENERATION AUTOLOGOUS CHONDROCYTE IMPLANTATION COMPARED WITH MICROFRACTURE IN THE KNEE: A PROSPECTIVE COMPARATIVE STUDY AT 5-YEAR FOLLOW-UP

E. Kon¹, A. Gobbi², G. Filardo¹, M. Delcogliano¹, C. Montaperto¹, M. Nitri¹, S. Zaffagnini¹, M. Marcacci¹

¹Department of Orthopaedic and Sports Trauma, Biomechanics Laboratory, Rizzoli Orthopaedic Institute (Bologna-IT); ²Orthopaedic Arthroscopic Surgery International (Milan-IT)

Introduction Various approaches have been proposed to treat articular cartilage lesions. However there are few studies comparing traditional (microfracture) *versus* second generation ACI Hyalograft C.

Objective The purpose of our study is to compare the clinical outcome of patients treated with second generation ACI Hyalograft C to those treated with the Microfracture at medium-term (5-year) follow-up.

Methods Eighty active patients with a mean age 29.8 (range 16–60) years and grade III-IV cartilage lesions of the femoral condyles or trochlea were treated with arthroscopic Hyalograft C and Microfracture ($n = 40/\text{group}$). All patients were prospectively evaluated and achieved a minimum five year follow-up. Included in the study are patients with knee pain or swelling and with grade III-IV chondral lesions of the femoral condyles or trochlea from 2.0 to 5.0 cm². Patients were excluded from the study if they have chondral lesions greater than 5.0 cm² or less than 2.0 cm², patella or tibial plateau chondral lesions, diffused arthritis or bipolar lesions, non-corrected axial deviation, knee instability, infection, tumor, metabolic and inflammatory pathology. Surgery was done by two experienced surgeons and patients underwent a uniform rehabilitation protocol. Patients were evaluated pre-operatively, 2 years post-op and 5 years post-op using physical examination scores, ICRS, and IKDC scores. Return to sports was assessed using Tegner scores at 2 and 5 years post-op. Statistical Analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software version 14.1 (SPSS Inc., Chicago, USA).

Results No significant difference was found between groups regarding the age, patient's sport activity level, presence of asso-

ciated surgery, defect size, and location. Both groups showed statistically significant improvement of all clinical scores from the preoperative interval to 5-year follow-up. When comparing the two groups, better improvement of the IKDC objective ($p < 0.0005$) and subjective ($p = 0.003$) scores were observed in the group treated with Hyalograft C at the 5-year follow-up. The return to sports after 2 years was observed to be similar using Tegner scores in both groups and remained stable after 5 years in the Hyalograft C group. Decrease in sports activity was observed in the microfracture group at 5 years. In both groups, older patients had more difficulties when attempting to return to the pre-injury sport activity level. However, the patient's age has not influenced the clinical outcome evaluated with the IKDC objective and subjective scores. Other parameters have not influenced statistically the clinical outcome in both groups.

Conclusions Both methods showed a satisfactory clinical outcome at medium-term follow-up. Better clinical results and sport activity were noted in the group treated with second generation autologous chondrocyte transplantation. This method may be used for the treatment of large femoral condyles cartilage lesions in the young active population, but long-term and randomized controlled studies will be needed to confirm these findings.

Level of evidence: Level II (Prospective comparative study).

COMPARISON BETWEEN DIFFERENT TYPES OF SUTURE CONFIGURATION IN MENISCAL REPAIR: A BIOMECHANICAL STUDY

L. Deriu, V. Izzo, A. Greco, S. Spinelli, G. Milano, C. Fabbriani

Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT)

Objective Comparing biomechanical properties of different types of meniscal suturing techniques in a porcine model.

Material and Methods One hundred-sixty porcine medial menisci underwent a full-thickness vertical lesion in their peripheral third, 3 millimeters away from the peripheral edge. Each lesion was repaired in a single site and then each meniscus was mounted on a biomechanical testing machine. We performed four different types of suture configuration: horizontal mattress (group 1), vertical *loop* (group 2), double vertical *loop* (group 3) and crossed (group 4). For each group, we performed meniscal repair using two different types of suture: Ethibond #0 (subgroup A), and Fiberwire #2-0 (subgroup B). For each subgroup, we used 10 samples to perform a load-to-failure test, and other 10 samples to perform a cycling loading test. Mean failure load, and elongation at 100 cycles were considered. Statistical analysis was performed to compare the groups with the Kruskal Wallis test, and Tukey's test for multiple paired comparisons. Significance was set at $p < 0.05$.

Results At the load-to-failure test series, double vertical and crossed sutures showed significantly higher failure load than horizontal mattress and single vertical suture, without a significant difference between them. Horizontal mattress sutures were significantly weaker than all the other groups. Fiberwire #2-0 showed significantly greater mean failure load for each type of suture configuration when compared with Ethibond #0. At cyclic loading test series, double vertical and crossed suture configuration showed significantly lower mean elongation than horizontal mattress and single vertical suture. Horizontal mattress suture group showed the greatest mean elongation. Fiberwire #2-0 showed significantly lower elongation than Ethibond #0, for each suture configuration.

Conclusions Double suture configurations (crossed and double vertical) showed better mechanical behaviour than single sutures.

Horizontal mattress showed worst results, regardless of the type of suture material used. Fiberwire #2-0 showed greater mean failure load and lower mean elongation than Ethibond #0, regardless of suture configuration used.

ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: SINGLE VERSUS DOUBLE BUNDLE AT 2-YEAR FOLLOW-UP

G.F. Trinchese, G. Iervolino, G. Calabrò, L. Prinzo, F. Tripodi, A. Toro

Department of Orthopaedic Surgery, "G. Fucito" Hospital (Mercato San Severino-Salerno-IT)

Objective Anterior Cruciate Ligament (ACL) consists of 2 distinct bundles, the antero-medial bundle (AMB) and posterolateral bundle (PLB). These 2 bundles have different roles in the control of knee stability. The AMB essentially controls the anterior tibial translation, whereas the PLB controls the internal rotation of the lateral tibial plateau. Traditional ACL reconstruction technique focused on reconstruction of one portion of ACL, the AMB, with good to excellent results. Current techniques do not completely reproduce the anatomy and function of the ACL. They control the anteroposterior stability of the knee near the extension, but are less efficacious in providing rotatory stability. To control the rotatory instability, many authors have suggested reconstructing not just the AMB but also the PLB. The purpose of our study was to compare clinical outcomes of double bundle ACL reconstruction with single bundle procedure.

Material and Methods We retrospectively studied 15 patients (group A) who underwent anatomic double bundle ACL reconstruction with the Freddie Fu technique, from June 2005 to June 2006. We compared the results to those of 15 patients who underwent, in the same year, to single bundle ACL reconstruction, using multistranded autologous hamstring tendons (group B). The 2 groups were similar regarding gender, age and activities. No patients had medial, lateral and posterior instability. No patients had cartilaginous lesions. Five patients had a medial meniscus rupture (3 in group A and 2 in B), 3 patients had a lateral meniscus lesion (1 group A, 3 group B) and 2 patients had a lesion of both menisci (1 group A, 1 group B). The mean follow-up was 28.3 months for the group A and 27.8 months for the group B. All patients underwent the same postoperative protocol.

Results We evaluated manual Lachman and pivot shift tests, maximum anterior tibial translation by Rolimeter and Lysholm and IKDC forms. We found no differences between A and B group patients regarding ROM, return to pre trauma activities and sports. The A group patients showed a minor residual anterior laxity and less cases of positive pivot shift test (glide) as rotational instability.

Conclusions Although clear limits of the study due to small number of cases, the results at 2-year follow-up are encouraging. We may, in fact, conclude that anatomic double bundle ACL reconstruction allows obtaining the same results, if not better, as single bundle reconstruction in terms of anterior and rotational stability.

SHOULDER AND ELBOW

TOTAL ELBOW ARTHROPLASTY FOR RECONSTRUCTION OF INTRA-ARTICULAR DISTAL HUMERAL FRACTURES

M. Papalia¹, G. Panegrossi¹, P. Petricca¹, F. Favetti¹, C. Barresi², F. Casella², F. Falez¹

¹Santo Spirito Hospital (Rome-IT); ²Rome American Hospital (Rome-IT)

Distal humeral fractures are rare although notoriously difficult to treat, especially in older people with osteoporotic bone, articular comminution and poor compliance.

In these patients, open reduction and internal fixation can be technically complex and associated with poor results.

Total elbow arthroplasty has been shown to offer a solution in these cases with good results in terms of joint stability and early mobilization in closed articular fractures with severe comminution (AO type C) and poor bone stock.

We present our experience with total elbow arthroplasty Conred-Morrey in 5 cases of complex articular distal humeral fractures in elderly patients (over 65) at a minimum follow-up of 1 year.

REPARABLE ROTATOR CUFF TEARS WITH CONCOMITANT LHB LESIONS: TENOTOMY OR TENOTOMY/TENODESIS?

A. De Carli, E. Zanzotto, A. Vadalà, M. Spoletini, G. Zampar, A. Ferretti

Orthopaedic Department, S. Andrea Hospital, "La Sapienza" University of Rome (Rome-IT)

Introduction Rotator cuff disease is a frequent issue usually involving over 50 years old people. As a rule it has a traumatic or a degenerative source. This last cause is often associated with a degeneration of the long head of the biceps tendon (LHB). The "gold standard" of this type of lesion is represented by the arthroscopic technique which allows to visualize and, if needed, to treat this kind of concomitant lesions. In this study we present the clinical, functional and ultrasonographic results of patients arthroscopically treated for a rotator cuff tear in which the LHB was simultaneously involved.

Material and Methods Thirty-five patients were surgically treated between 2004 and 2007 for a reparable lesion of the rotator cuff in which a concomitant degenerative lesion of the LHB was detected and treated. Patients were randomly assigned to two different groups: group A, patients with tenotomy/tenodesis treatment of the LHB; group B, patients with simple tenotomy of the LHB. At follow-up patients underwent physical examination and Simple Shoulder Test (SST) and the Constant and Murley (CM) scales. Moreover patients performed a dynamometric test to objectively measure the strength recovery of the operated shoulder. The same expert radiologist also performed an ultrasonographic evaluation of the shoulder to exactly evaluate the localization of the treated LHB and to calculate its vascularization status.

Results All patients were clinically, functionally and radiologically followed-up at a medium of 29 months (range: 12–45 months). Twenty-five patients entered group A and ten patients the group B. SST scale showed a medium result of 11.7 in group A and 10.6 in group B; CM scale showed a medium result of 97.2 in group A and 94.6 in group B. Both functional and dynamometric results showed no statistically significant differences between the two groups. Ultrasonographic exam showed the presence of the LHB in its sulcus in 80% of patients of both groups; a satisfactory vascularization of the LHB was detected in 20% of patients of group A and 40% of patients of group B.

Conclusions No statistically significant differences were detected among the two groups under all points of views. Tenotomy/tenodesis operation does not seem to improve clinical and functional results in the medium-long term follow-up when compared to the simple tenotomy operation.

COMPARISON BETWEEN SINGLE-ROW AND DOUBLE-ROW TECHNIQUE IN THE ARTHROSCOPIC TREATMENT OF ROTATOR CUFF LESIONS: A PROSPECTIVE RANDOMIZED STUDY

A. Grasso¹, G. Falcone¹, M. Salvatore¹, S. Salvatori¹, L. Deriu², G. Milano²

¹Casa di Cura Villa Valeria (Rome-IT); ²Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT)

Objective Comparing the clinical outcome of arthroscopic repair of full-thickness rotator cuff tears with single-row and double-row technique in a prospective randomized study.

Material and Methods Eighty patients with a full-thickness tear of the posterior-superior rotator cuff underwent an arthroscopic repair with metal suture anchors. They were divided into two groups of 40 patients each, according to repair technique: single-row technique in group 1, and double-row technique in group 2. Exclusion criteria were: partial-thickness and irreparable cuff tears, subscapularis tears, labral pathology, os acromiale, degenerative arthritis of glenohumeral joint and acromioclavicular joint, rotator cuff arthropathy, previous surgery to the same shoulder, and workers' compensation claims. Results were evaluated using the Constant score normalized for age and gender, and the DASH and Work-DASH self-administered questionnaires. On analyzing the results at a two-year follow-up, we considered the following independent variables: age, gender, dominance, location, shape, and area of cuff tear, tendon retraction, fatty degeneration of cuff muscles, treatment of the biceps tendon, and rotator cuff repair technique. Univariate and multivariate statistical analysis were performed in order to find out variables that were independently associated to the outcome. Significance was set at $p < 0.05$. The null hypothesis was that differences between the two groups were not significant.

Results Eight patients (10%) were lost at follow-up: 3 in group 1 and 5 in group 2. Comparison between groups did not show significant differences for each variable considered. Overall results for Constant score were 100.5 points in group 1 and 104.9 points in group 2; for DASH score were 15.4 points in group 1 and 12.7 points in group 2; for Work-DASH score were 16.0 points in group 1 and 9.6 points in group 2. Univariate and multivariate analysis showed that only age and gender significantly and independently influenced the outcome. Differences between groups 1 and 2 were not significant for each scoring system considered. Therefore, the null hypothesis was not rejected.

Conclusions At a short-term follow-up, arthroscopic repair of rotator cuff tears with double-row technique showed slightly better clinical outcome than single-row repair, although the difference was not significant.

RANDOMIZED CONTROLLED TRIAL COMPARING THE EFFECTS ON SHOULDER FUNCTION OF REPAIRING OR NOT A TYPE II SLAP LESION WHEN ASSOCIATED WITH ROTATOR CUFF REPAIR IN PATIENTS OVER 50

F. Franceschi¹, U.G. Longo¹, L. Ruzzini¹, G. Rizzello¹, N. Maffulli², V. Denaro¹

¹Department of Orthopaedic and Trauma Surgery, Campus Biomedico University (Rome-IT); ²Department of Trauma and Orthopaedic Surgery, University Hospital of North Staffordshire, Keele University School of Medicine (Stoke on Trent-UK)

Objectives Several studies showed the efficacy of arthroscopic repair for Type II SLAP lesions without other associated lesions,

but the only data reported on the association of arthroscopic repair of Type II SLAP lesion and rotator cuff tears involve young and active patient. To our knowledge, no studies have focused on patients over 50. We evaluated the results of a randomized controlled trial of arthroscopic repair in patients over 50 with rotator cuff tears and Type II SLAP in whom the repair was performed either repairing the two lesions, or repairing the rotator cuff tears and performing a tenotomy of the long head of the biceps.

Methods We recruited 63 patients. In 31 patients, we repaired the rotator cuff and the Type II SLAP lesion (Group 1). In the other 32 patients, we repaired the rotator cuff and tenotomized the long head of the biceps (Group 2). Seven patients (2 in the group 1 and 5 in the group 2) were lost at final follow-up. A modified UCLA shoulder rating scale was used to evaluate pre-operative and post-operative shoulder pain, function, active forward flexion, strength and patient satisfaction.

Results Of 63 patients randomized to one of the two treatments, 5.2 year results were available for 56. Seven patients (2 in the group 1 and 5 in the group 2) did not return at the final follow-up. Statistically significant differences were seen with respect to the UCLA score and ROM values at final follow-up. In Group 1 (SLAP repair and rotator cuff repair), the UCLA showed a statistically significant improvement from a pre-operative average rating of 10.4 (range 6 to 14) to an average of 27.9 (24–35) post-operatively ($p < 0.001$). In Group 2 (biceps tenotomy and rotator cuff repair), the UCLA showed a statistically significant improvement from a pre-operative average rating of 10.1 (range 5 to 14) to an average of 32.1 (range 30 to 35) post-operatively ($p < 0.001$). There was statistically significant difference in total post-operative UCLA scores and ROM when comparing the two groups post-operatively ($p < 0.05$).

Conclusions Arthroscopic management has been recommended for some SLAP lesions, but no studies have focused on patients over 50 with rotator cuff tear and Type II SLAP lesion. We compared the clinical outcome of patients over 50 affected with rotator cuff tears and Type II SLAP lesion whose both defects were repaired, or the rotator cuff tear was repaired and the long head of the biceps tendon was tenotomized. In our hands, the association of rotator cuff repair and biceps tenotomy provides better clinical outcome compared with repair of Type II SLAP lesion and of the rotator cuff. The repair of the two defects, in fact, can lead to worst clinical results compared with association. Rotator cuff repair alone is sufficient to determine a good post-operative outcome, allowing to avoid post-operative stiffness of the shoulder.

COMPARISON BETWEEN METAL AND BIODEGRADABLE SUTURE ANCHORS IN THE ARTHROSCOPIC TREATMENT OF ANTERIOR-INFERIOR SHOULDER INSTABILITY: A PROSPECTIVE RANDOMIZED STUDY

L. Deriu¹, V. Izzo¹, A. Grasso², M. Salvatore², G. Milano¹, C. Fabbriani¹

¹Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT); ²Casa di Cura Villa Valeria (Rome-IT)

Objective Comparing the clinical outcome of arthroscopic treatment of traumatic anterior-inferior shoulder instability with metal and biodegradable suture anchors in a prospective randomized study.

Material and Methods Seventy-eight patients with recurrent anterior-inferior shoulder instability underwent an arthroscopic repair with suture anchors. They were randomly divided in two groups of 39 patients each, according to the type of suture anchors used: metal in group 1, and biodegradable in group 2. Exclusion criteria were: multidirectional instability, capsular

avulsion from the humeral head (HAGL and RHAGL lesions), associated rotator cuff tears, and severe humeral and/or glenoid bone loss. Results were evaluated using the DASH self-administered questionnaire, Rowe score, and Constant score normalized for age and gender. On analyzing the results at a two-year follow-up, we considered the following independent variables: age, gender, dominance, type of work (manual or sedentary), type of sport (contact, non contact, overhead), sport activity level (recreational, agonistic, professional), timing from first episode of dislocation to surgery, age at the first dislocation, number of dislocations, pathology of glenoid labrum, and anterior-inferior glenohumeral ligament (AIGHL), associated SLAP lesions, and type of suture anchors (metal or biodegradable). Univariate and multivariate statistical analysis was performed in order to find out variables that were independently associated to the outcome. Significance was set at $p < .05$. The null hypothesis was that differences in clinical outcomes between the two groups were not significant.

Results Eight patients (10.3%) were lost at follow-up: 3 in group 1, 5 in group 2. Among them, 1 case from group 1, and 2 from group 2 reported recurrence of dislocation. None of the patients visited at follow-up referred recurrence of dislocation. Comparison between groups did not show significant differences for each variable considered. Overall results for DASH score were 6.8 points in group 1 and 7.0 points in group 2; for Rowe score were 88.7 in group 1 and 92.9 in group 2; for Constant score were 95.8 points in group 1 and 97.6 points in group 2. Univariate and multivariate analysis showed that differences between groups 1 and 2 were not significant for each scoring system considered. Therefore, the null hypothesis was not rejected.

Conclusions At a short-term follow-up, no significant differences were observed in the clinical outcome of arthroscopic treatment of traumatic shoulder instability when performed with metal or biodegradable suture anchors. Recurrence rate was 2.6% in group 1 and 5.2% in group 2 (overall rate: 3.8%).

RECURRENT ULNAR-NERVE DISLOCATION AT THE ELBOW: PROPOSAL FOR A NEW SURGICAL TECHNIQUE

A. Parlato, M. Ferruzza, N. Galvano, M. D'Arienzo

Clinica Ortopedica e Traumatologica, Università degli Studi di Palermo (Palermo-IT)

The dislocation of ulnar nerve at the elbow was described for the first time by Blattmann in 1851, and it is responsible of a neurological symptomatology similar to that of the classical compression of the nerve, it is also lighter than that, and with so vanished aspects to make diagnosis difficult. The purpose of the study was to propose a new surgical technique. The diagnosis of dislocation of the nerve is based on an accurate anamnesis, on a possible positiveness of the EMG, and on the clinical examination characterized by the evidence of partial or complete spillage of the nerve from his lodging during elbow bending. The essential diagnostic technique is dynamic ultrasound, that allows identifying the anomalous movements of both the nerve and the apex of the epitroclea. The proposed surgical treatment is the release of the ulnar nerve and its reinsertion in the anatomical center through the use of a big fibrous-adipose edge that is sutured with disconnected points reconstructing the epitrocleo-olecranic ligament. We used this technique in 10 young patients with very satisfactory results. The anterior transposition deep submuscular is the surgical treatment of routine mostly used and recommended but the treatment of release and reinsertion of the nerve in the anatomical center gives satisfactory results in young patients because it is

more conservative and it clearly engraves in a smaller way on the post-operating muscular strength.

USE OF COPELAND'S COVERING PROSTHESIS IN PRIMARY SHOULDER OSTEOARTHRITIS: OUR FIRST EXPERIENCE

A. Tomasi¹, D. D'Antona², F. Mecchia^{1,2}

¹Ortopedia e Traumatologia, Ospedale di Spilimbergo (Spilimbergo-IT); ²Ortopedia e Traumatologia, Ospedale di S. Vito al Tagliamento (S. Vito al Tagliamento-IT)

Objective The authors evaluate the short-term results concerning the use of Copeland's covering prosthesis in shoulder osteoarthritis.

Material and Methods Between October 2003 and October 2007 we installed a Copeland's covering emiarthroplasty in 27 patients, 8 males (30%) and 19 females, 26 affected by primary osteoarthritis and 1 by rheumatoid arthritis, without rotator cuff tears. Mean follow-up was 28.5 months (range, 9–52 months); mean age was 65.8 years. All patients were evaluated clinically preoperatively and after surgery by Constant scale, and radiographically by X-ray. A MRI was performed preoperatively. Operations have been performed under general anesthesia and delto-pectoral approach.

Results Constant score increased 37 points from preoperative to post-operative (range, 19–61). All patients obtained active elevation at least 90°. None of the patients presented either X-ray shining around the prosthesis or slide. One patient contracted a deep infection and underwent surgery revision.

Conclusions As reported by Copeland in 2003 the long-term results of the covering prosthesis in shoulder osteoarthritis, turned out similar to other prosthesis types. In our experience we obtained a significant improvement of shoulder function. The 75% of patients showed a good or excellent outcome.

ARTHROSCOPIC REVISION SURGERY OF FAILED ARTHROSCOPIC BANKART REPAIR

F. Franceschi¹, U.G. Longo¹, L. Ruzzini¹, G. Rizzello¹, N. Maffulli², V. Denaro¹

¹Department of Orthopaedic and Trauma Surgery, Campus Biomedico University (Rome-IT); ²Department of Trauma and Orthopaedic Surgery, University Hospital of North Staffordshire, Keele University School of Medicine (Stoke on Trent-UK)

Objectives The surgical management of recurrent anterior shoulder instability after failed surgery is challenging. Patients with failed arthroscopic Bankart repairs can be successfully treated with a further open Bankart repair, which allows a direct repair of the capsulo-labral anterior-inferior defect and capsular tightening. Potential disadvantages of the open Bankart repair include postoperative stiffness and subscapularis deficiency, as the latter must be detached in open procedures. The present study evaluated prospectively the surgical outcomes of arthroscopic revision repair of Bankart lesions in a cohort of patients who underwent an arthroscopic Bankart repair and, subsequently developed postoperative recurrent anterior instability.

Methods Between January 2000 and October 2003, we performed a prospective cohort study of a consecutive series of patients who sustained an arthroscopic Bankart repair and developed postoperative recurrent anterior instability. Ten patients (8 male and 2 female, mean age at revision 25.6 years; range 18 to 41) were

recruited. The mean interval from the time of the revision surgery to the final follow-up was 68 months (range 46 to 83). Objective testing included preoperative and postoperative range of motion. Outcome measures included the rating system of University of California at Los Angeles (UCLA). The surgical procedure was performed in a consistent manner: capsular plications, suture anchor repair of the displaced labrum, and, when indicated, rotator interval closure. Descriptive statistics were calculated. The results of surgery were compared using the Wilcoxon Sign Rank test. Significance was set at $p < 0.05$.

Results The UCLA rating system showed a statistically significant improvement from a preoperative average rating of 11.7 (range, 6–14) to an average of 31.7 (range, 29–35) postoperatively ($p < 0.05$). We followed-up patients for a mean of 68 months (46 to 83 months). All patients had a full and equal postoperative range of motion compared with the preoperative range of motion. One patient experienced recurrent dislocations after the salvage procedure. None of the other nine patients experienced a recurrent dislocation, with all of them returning to their previous sports level.

Conclusions Causes of recurrence after primary Bankart repair have been related to various factors. Patients with bone loss are at risk for recurrent instability after arthroscopic Bankart repair. In presence of bone deficiency (the engaging Hill-Sachs lesions and the inverted pear glenoid), an open bone restoring procedure (i.e. Latarjet procedure) should be carried out. Other risk factors are shoulder hyperlaxity, nonanatomic repair of the capsulolabral tissue (i.e. medialization of the capsulolabral tissue), insufficient number of sutures, and inadequate postoperative immobilization. To optimize success with the arthroscopic technique, there are a number of factors that must be considered. The first factor is patient selection. Patients with bone loss or with shoulder hyperlaxity are at risk for recurrent instability after arthroscopic revision Bankart repair. Moreover, at arthroscopy the labrum must be mobilized and the glenoid neck must be properly decorticated to produce a bleeding bed that allows soft tissue to heal to bone. Return to sports should be delayed until full range of motion and normal strength has been regained, which usually takes 5 to 6 months. In conclusion, arthroscopic Bankart revision surgery using suture anchors is a reliable procedure with respect to recurrence rate, range of motion and shoulder function in carefully selected patients.

MODIFIED ARTHROSCOPIC DOUBLE-PULLEY TECHNIQUE FOR DOUBLE-ROW ROTATOR CUFF REPAIR: PRELIMINARY RESULTS

C. Tudisco, A. Febo, E. Savarese

Department of Orthopaedic Surgery, "Tor Vergata" University (Rome-IT)

Objective Double-row rotator cuff repairs [1] are becoming popular to improve contact area between tendon and bone. We described an arthroscopic technique to maximize the footprint contact area for rotator cuff repair.

Material and Methods This study included a consecutive series of 30 patients with full-thickness rotator cuff tears underwent arthroscopic modified double-pulley for double-row rotator cuff repair with use of suture anchors. Data were collected prospectively between 1–3 weeks before surgery and at 6 to 14 months after surgery. Outcome was assessed via UCLA Form and Modified-ASES Form. The technique that we used is the following: two suture anchors (1 anterior and 1 posterior) are inserted at the articular margin of the greater tuberosity. For each anchor, two strands of different colour passed through a single point of the torn cuff and the other two in another single point of the torn cuff. In this way, the 4

strands from antero-medial anchor are passed through a double point and the 4 strands from postero-medial anchor are passed through a double point. A suture strand from the antero-medial anchor is tied with a suture strand (same colour) from the postero-medial anchor extracorporeal. This extracorporeal knot is delivered into the joint to restore the medial footprint. A free strand from the antero-medial anchor and a free strand from the postero-medial anchor are tied together with a pushlock in the postero-lateral place. A free strand from the antero-medial anchor and a free strand from the postero-medial anchor are tied together with a pushlock in the antero-lateral place.

Results At follow-up all patients showed a significant improvement. The preoperative UCLA score was 8.2, the postoperative UCLA score was 30.8. The preoperative Modified-ASES score was 18.2, the postoperative Modified-ASES score was 34.8.

Discussion In our retrospective study we found that the preliminary results with this new technique are very good. However we need a longer follow-up to see if the demonstrated biomechanical advantages of Double-Row [2, 3] technique give also clinical improvement when compared with Single-row rotator cuff repairs.

Conclusion This technique produces a larger footprint and may potentially improve clinical results.

References

1. Arrigoni P, Brady PC, Burkhart SS (2007) The double-pulley technique for double-row rotator cuff repair. *Arthroscopy* 23(6):675.e1–4
2. Smith CD, Alexander S, Hill AM, Huijsmans PE, Bull AM, Amis AA, De Beer JF, Wallace AL (2006) A biomechanical comparison of single and double-row fixation in arthroscopic rotator cuff repair. *J Bone Joint Surg Am* 88(11):2425–2431
3. Milano G, Grasso A, Zarelli D, Deriu L, Cillo M, Fabbriani C (2008) Comparison between single-row and double-row rotator cuff repair: a biomechanical study. *Knee Surg Sports Traumatol Arthrosc* 16(1):75–80

SHORT-TERM TO MEDIUM-TERM OUTCOMES OF THE PYROCARBON RADIAL HEAD PROSTHESIS

M. Zanlungo, E. Finardi, S. Cigni

3A U.O. Ortopedia, Centro di Chirurgia dell'Arto Superiore, Istituto di Cura Città di Pavia (Pavia-IT), e-mail: mariozanlungo@libero.it / mario.zanlungo@grupposandonato.it

Objective Because the anatomy of the radial head is difficult to be reproduced with a prosthesis [1], three different options have been proposed: a monoblock prosthesis with a smooth stem, a bipolar prosthesis with a fixed stem and a mobile head, a modular Pyrocarbon radial head prosthesis. One concern with a fixed-stem implant with a mobile head has been the risk of osteolysis [1]. The purpose of this study was to evaluate radiographic changes reflecting or suggesting progressive osteolysis in patients with Pyrocarbon radial head prosthesis.

Material and Methods The functional and radiographic outcomes following treatment of ten Pyrocarbon radial head prosthesis in ten consecutive patients (5 F, 5M; mean age 52.1 years; min 38, max 72; 5 left, 5 right) were evaluated at a mean of 2.5 years postoperatively (range, 18–48 months). There were seven comminuted fractures involving the entire radial head, with post-traumatic arthritis and one primary degenerative arthritis. Three fractures were associated with a ulnar fracture and posterior elbow dislocation, two patients had a Essex Lopresti lesion, one had elbow instability and one heterotopic ossification in unreduced posterior dislocation.

Results According to the Mayo Elbow Performance Index, three elbows were graded as excellent; four, as good; one, as fair; and

too, as poor. Radiographic changes never reflected a progressive osteolysis. Complications occurred in patient affected by primary degenerative arthritis: after cast removing had head prosthesis luxation with consequent prosthesis removing. Complications also occurred in women affected by unreduced posterior dislocation who had severe extension (-70°) and pronation (-50°)-supination (-60°) stiffness caused by recurrent heterotopic ossification.

Discussion and Conclusions Satisfactory midterm functional results were achieved in seven of the ten patients. The high prevalence of poor results in three cases affected by degenerative arthritis suggested the postero-lateral rotatory stress in the coronoid [2] causing severe pain and radiocapitellar subluxation for the rigid prostheses. The absence of adverse radiographic changes must be checked in long term results.

References

1. Yian E, Steens W, Lingenfelter E, Schneeberger AG (2008) Malpositioning of radial head prostheses: An in vitro study. *J Shoulder Elbow Surg* 17(4):663–670
2. Popovic N, Lemaire R, Georis P, Gillet P (2007) Midterm results with a bipolar radial head prosthesis: radiographic evidence of loosening at the bone-cement interface. *J Bone Joint Surg Am* 89(11):2469–2476

SHOULDER SMR ARTHROPLASTY: OUR EXPERIENCE

A. Causero, A. Beltrame, P. Di Benedetto

Clinica Ortopedica e Traumatologica, Università degli Studi di Udine (Udine-IT), e-mail: causero.araldo@aoud.sanita.fvg.it

Degenerative joint disease of the glenohumeral joint is due to several factors with pathologic changes like, for instance, rotator cuff biomechanics function, superior migration of humeral head, glenoid erosion. Modular implants are designed, in order to solve all the pathologic changes and to restore joint biomechanics. In our experience we performed some shoulder arthroplasties using the SMR (Shoulder Modular Replacement) implant. Even though the use we made with this prosthetic implant is limited in number of cases and follow-up, it provided us with good results. Considering its modularity and design characteristics, offering some advantages, we are still using this implant to figure final conclusions out. SMR prosthesis offers interchangeable solutions, applicable to every pathology. It foresees a humeral common stem and humeral specific bodies for concentric arthritis, fractures, rotator cuff irreparable tears and revision arthroplasty. Revision surgery can also use longer stems both cemented and cementless. Cementless glenoid allows joining with polyethylene or with glenosphere if inverse geometry implant is used. Modular components are assembled by using a cone morse system, which allows to vary all anatomical fundamental parameters like implant height, humeral neck length, humeral body retroversion, medial and posterior offset of humeral head and humeral head size.

Humeral stems used in election surgery are cementless. They have a triple conicity in their extension to obtain a better primary proximal fixation independently from the canal morphology. The finned stem section is stellar and it is inserted by striking without reaming to avoid torsion movements. Target of its insertion is to take metaphyseal fixation inside trabecular bone. There are also a cemented stem and a cementless half-knurled stem to treat acute fractures, but they are infrequently used.

Humeral body has one size for degenerative joint disease treatment. It has sand-blasted surface with wings so as to form a unique body with the stem. In case of fracture there are 3 different body sizes with 3 mm variation each. The humeral body has also holes for tuberosity synthesis.

Glenoid component is proposed for cemented and cementless fixation. Cementless component, coated with hydroxyapatite, is produced with 2 sizes. It is composed by a central pivot that allows bone growth and it has an edging-like structure to guarantee primary stability. For better stability two screws can be used. Implant final stability is guaranteed by osteointegration of glenoid-bone interface and by bone growth inside central pivot of body, getting a different fixation in comparison with other implants based predominantly on screw fixation.

BASIC SCIENCE 1

MECHANICAL BEHAVIOUR OF LOCKED-PLATES

R. Valentini¹, B. Martinelli¹, F. Cosmi², M. Hoglievina², P. Nogherotto²

¹Orthopaedic and Traumatologic Clinic, University of Trieste, Cattinara Hospital (Trieste-IT); ²Department of Mechanical Engineering, University of Trieste (Trieste-IT)

The biological osteosynthesis with mini-invasive technique has revolutionized the concepts of fracture's healing. In order to preserve the hematoma of the fracture and the periosteal vascularisation have been proposed different plates according to the concept of the internal fixator. Locked-plate fracture-fixation techniques and designs continue to evolve.

In collaboration with the Department of Mechanical Engineering of the University of Trieste we studied the mechanical behaviour of three different designs of plate-screw fixation. The first constructive solution proposes a joint between the screw and the plate by threading coupling, the second uses a titanium insert, screwed in a steel plate, in which is fitted the head screw. The third system considers a head screw with three "ramps" which couple themselves in the hole with three helical "slides". The hole in the plate presents a rather conical feature, which prevents the screw from moving axially, while it is free to rotate thanks to the spherical shape of the head. 3D-CAD and FEM models were used to simulate the behaviour of each device component.

To characterize the mechanical behaviour of the relation between the screw and the plate we considered two typical loading conditions: traction (tension) in the screw (pull out of the screw from

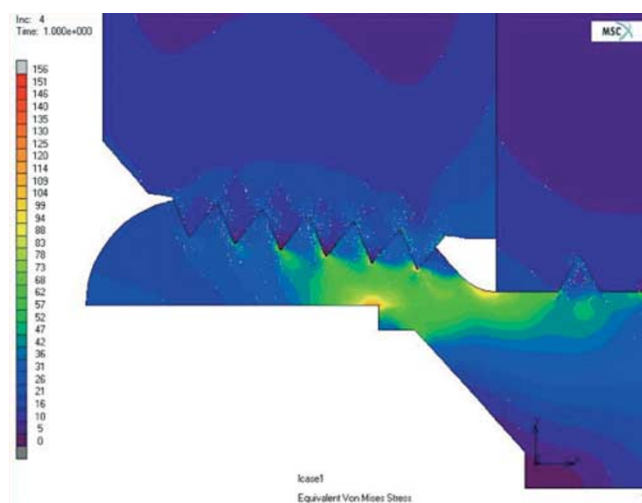


Fig. 1 SCF of the first screw typology

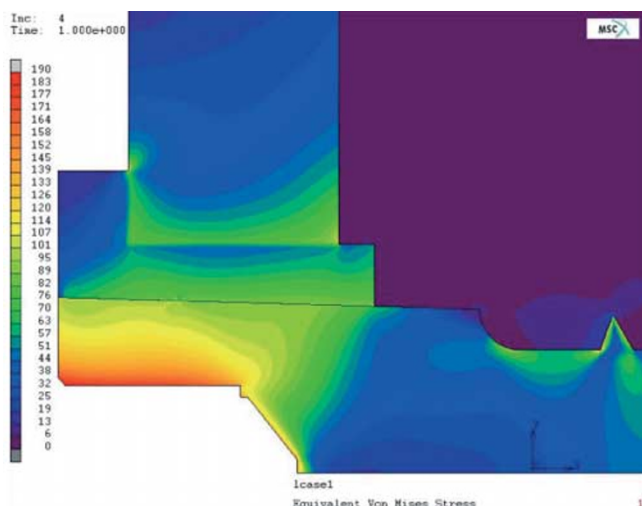


Fig. 2 SCF of the second screw typology

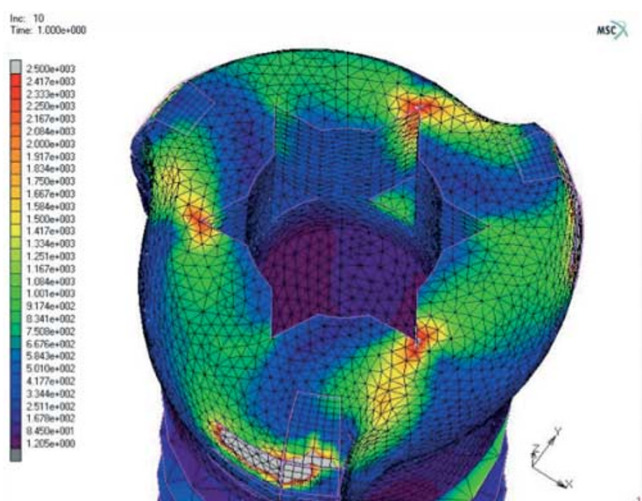


Fig. 3 SCF of the third screw typology

the bone) and the bending of the screw in the hole of the plate. The performances of the screws were compared using the concentration stress factor (SCF) with reference to the nominal screw diameter.

The results can be reassumed in relation to the traction-strength (tension): the SCF of the first typology is 4.8 (Fig. 1), for the second one is 3.2 (Fig. 2) and for third are 11.7 (Fig. 3). If the bending stress is considered the results are more similar: the SCF is 2.45 for the first, 1.44 for the second, and 2.52 for the third.

In conclusion the mechanical behaviour of the three typologies are quite similar, even if we can say in relation to the classical first screw typology, the second one seems to show a better load distribution and the third one offers different possibilities of rotation with different angular insertion but with higher stress at the level of the hole and of the head of the screw.

Suggested readings

1. Wirtz DC, Schiffers N, Pandorf I, Radermacher K, Weichert D, Forst R (2000) Critical evaluation of known bone material properties to realize anisotropic FE-simulation of the proximal femur. *Journal Biomech* 33:1325–1330
2. Valentini R, Martinelli B, Cosmi F, Hoglevina M, Nogherotto P (2007) Mechanical Behavior of One Internal Fixator (O'nil

Plate and Screws System): A Finite Element Study and Clinical Experiences. *Techniques in Orthopaedics. Locked Plating: Biomechanics & Biology and Clinical Indications, Part I.* 22(3):173–180

THE NESTED SPINAL ROD: LABORATORY TESTS OF A NEW SPINAL IMPLANT CONSTRUCT

D.A. Fabris Monterumici¹, C. Miglietta², G. Pennati², R. Sinigaglia¹

¹Padova-IT; ²Milan-IT

Scope Aim of our report was to evaluate the resistance and the static properties of a new spinal implant construct for lumbar arthrodesis, not to define levels of performance, safety, and applicability of the construct.

Introduction Today lumbar spinal arthrodesis is usually performed using implants of several components (vertebral attachment components, transverse elements, and longitudinal elements). Sometimes implant constructs fail. Improve static and dynamic properties of implant construct means improve spinal arthrodesis. To improve mechanical properties of spinal constructs, a new implant with a nested rod was designed and tested. **Material and Methods** The resistance of the component interconnection was evaluated using accordance with ASTM 1978 (1997) Standard, the strength of the construct was measured in accordance with ASTM 1717 (2001) Standard. Static properties of the new implant construct were compared to an old one. The test samples are assembled from the spare materials as specified by the manufactures. The samples tested are made of previously unused parts only and are not re-tested. The test constructs are labelled and maintained according to good laboratory practice. The tests were performed on a MTS 358.02 MiniBionix servohydraulic testing machine, equipped by an axial-torsional hydraulic actuator. The loads applied to the test sample were measured by a MTS axial/torsional calibrated load cell. Axial gripping capacity of the interconnection mechanism, flexion-extension moment capacity of the interconnection mechanism, static compression bending test, and fatigue tests of the spinal implant construct were tested.

Results Axial gripping capacity of the new interconnection mechanism was 3–4 times higher than old constructs (4563–6238 N *versus* 1031–1427 N). Flexion-extension moment capacity of the new interconnection mechanism was lightly superior *versus* old constructs (32.1–38.19 Nmm *versus* 19.96–30.22 Nmm). Static compression-bending of the new spinal implant construct were similar to the old ones, but failure for bars yielding and not for slipping or failure of the interconnection mechanism. Fatigue tests showed no implant failure using 300 N load (>2,500,000 cycles), and screw shank failure after 2,481,919 cycles with 360 N, 10,634 cycles using 600 N, and 2556 cycles using 900 N.

Conclusions The new nested spinal implant construct have superior axial gripping and flexion-extension capacities versus conventional spinal implants, maintaining static compression-bending *in vitro* properties. Fatigue properties are excellent. Further studies are necessary to evaluate appropriate health and safety practices, and determine its clinical *in vivo* applicability.

EXPERIMENTAL SURGERY FOR THE RESURFACING OF HYALIN CARTILAGE

A.F. Manunta, F. Marras, F. Pisanu, P. Tranquilli Leali

Orthopaedic Department, University of Sassari (Sassari-IT)

Aim Numerous preclinical projects of various articular cartilage repair procedures were performed in the Orthopaedic Department of Sassari to obtain a scientific model useful for human race.

Material and Methods A condral lesion of medial femoral condyle in a sheep experimental model was performed; we resurfaced articular cartilage by using periosteum flap, chondrocytes culture, adipose corpus of Hoffa and embryonic stem cells. The obtained data were compared with histological-immunohistochemical data and we employed the Artscan 200 to asses and compare regenerative cartilage tissue stiffness.

Results Parametres that affected final results are:

1. *Animals models*: joint mechanics, weight-bearing, thickness of articular cartilage.
2. *Surgical approach*: critical size defects that do not penetrate the calcified cartilage *versus* those that do it are crucial; other factors are: contained lesion, cells, matrices, and soluble regulators.
3. *Methods of evaluation* (a) histology findings: the types of tissue filling the defect (including cell and extracellular matrix characteristics), attachment to adjacent structures (articular cartilage, calcified cartilage or bone like overgrowing bone and tide mark) and health of the adiacent tissue; these findings can reveal structural information, primarily collagen organization which gives a general idea of a functionality of the reparative tissue; (b) scanning electron microscopy: useful for detecting the surface and neighbouring tissues; (c) biochemistry analysis: several staining methods are specific to sulphated glycosaminoglycan (Safranina O, alcian blue) where immunoistochemical stains can be used to show collagen type and other cartilage specific protein.
4. *Biomechanical tests*: the biomechanical analysis is usually focused on synthesis of major components of the cartilage extracellular matrix: collagen and proteoglycan; the weakness is due to variation in mechanical properties of articular cartilage between different species, due to variation in cartilage thickness, inaccessible areas due to joint geometry, instrument size and shape, loss of surface integrity, not easy contact between the indenter ending and cartilage surface, ease to slide by indenter on the articular surface with possibility destructive action of probe.
5. *Postsurgical treatment*.

Conclusions In the current study the primary outcome variable was histology, whereas in clinical work it is pain relief. The advantage of a second look in an experimental model should be interpreted with caution and efforts should be made to verify them in human studies, but these findings may inform future strategies for cartilage repair.

ASSOCIATION BETWEEN IL-6 AND MMP-3 GENE POLYMORPHISMS AND ADOLESCENT IDIOPATHIC SCOLIOSIS (AIS): A CASE-CONTROL STUDY

E. Pola, L. Oggiano, G. Logroscino, L. Nasto, L. Aulisa, C.A. Logroscino

Department of Orthopaedics, School of Medicine, Catholic University (Rome-IT)

Inflammation plays a key role in the aetiology of intervertebral disc degeneration. Recent studies suggest a possible contribution of pro-inflammatory gene polymorphisms in the pathogenesis of adolescent idiopathic scoliosis (AIS). In this study we suggest a possible role of the MMP-3 and IL-6 gene polymorphisms in the pathogenesis of AIS. The nucleus pulposus of scoliotic discs responds to exogenous stimuli by secreting interleukin-6 (IL-6) and other inflammatory cytokines. The association between matrix metalloproteinases (MMPs) and disc degeneration has been reported by several inves-

tigators. A human MMP-3 promoter 5A/6A gene polymorphism regulates MMP-3 genes expression, while the G/C polymorphism of the promoter region of IL-6 gene influences levels and functional activity of the IL-6 protein. We conducted a case-control study on 259 patients (53 scoliosis and 206 controls) to investigate whether the 5A/6A polymorphism of the MMP-3 gene and the G/C polymorphism of the promoter region of IL-6 gene were associated with susceptibility to AIS.

The frequency of the 5A/5A genotype of MMP-3 gene polymorphism in patients with scoliosis was almost 3 times higher than in controls (30.2 % vs. 11.2 %, $p = 0.001$) and the frequency of the G/G genotype of IL-6 gene polymorphism in patients with scoliosis was almost 2 times higher than in controls (52.8 % vs. 26.2 %, $p < 0.001$). 5A/5A genotype of MMP-3 gene polymorphism and G/G genotype of IL-6 gene polymorphism are independently associated with a higher risk of scoliosis (odds ratio respectively 3.34 and 10.54).

This is the first study that has evaluated the possibility that gene variants of IL-6 and MMPs might be associated with scoliosis and suggests that MMP-3 and IL-6 promoter polymorphisms constitute important factors for the genetic predisposition to scoliosis.

NEW FRONTIERS IN THE EMPLOYMENT OF MSCS + GROWTH FACTORS IN ORTHOPAEDICS

J.M. Taglioretti¹, L. Santoleri²

¹C.T.O.-I.C.P. (Milan-IT); ²Niguarda Ca' Granda Hospital (Milan-IT)

Background The success of osteogenetic activation in bone defect with the employment of "biological lus", MSCs (CFU-F) activated by AGF (autologous growth factors), depends both on the drawing methods and on concentration, and, above all, on the patient's clinical conditions, when drawing (Connolly J.F., 1991; Muschler G.F., 1997, 2002, 2005). Some improvements in the drawing techniques and new methods of concentration can secure the graft with a sufficient quantity of osteogenerating cells, computable also *in vitro*, even on critical conditions (age, sex, systemic or local bone disease, endocrine disease, drugs acting on bone metabolism). The employment of growth factors of platelet derivation from a donor offers a new opportunity to all those patients who are ineligible to the conventional methods of AGF preparation owing to contingent situations such as acute traumas or hematological problems (lack in platelets, coagulopathy, therapy with ASA, TAO, FANS).

Material and Methods Since February 2006, 8 patients suffering from pseudoarthrosis ($n = 4$, 2 femoral bones and 2 tibial bones), prosthetic mobilizations ($n = 3$), NAV ($n = 1$) have been treated at the Orthopaedic Clinical C.T.O., Milan, in collaboration with the Transfusion Service of Niguarda Hospital, Milan, by employing concentrated MSCs + GF from donor. The patients have been monitored by checking the pre-post operative phlogosis haematochemical parameters and after 1, 2, 4 weeks, pre-post operative Rx and after 1, 2, 6, 12, 24 months; NAV also with preoperative RNM and after 2, 6, 12 months.

Results No unfavourable event, no local or systemic allergic reaction, no infections have been recorded. The patients attain clinical and radiological recovery resulting steady after checking. The method is subjected to the same rules applied to haematic transfusions and to the non-transfusional employment of haemocomponents.

Discussion and Conclusions The selection procedures of donors enable us to obtain a more uniform product as to activity and concentration than we commonly obtain from the employment of autologous drawing, but, above all, they increase the availability hypothetically extensible to bank-like allotment. The authors are

satisfied with the results and suggest a wider spreading of this method.

CHONDROCYTES IN VITRO DENSITY AND CELLULAR PHENOTYPE

D. Deponti¹, L. Mangiavini², A. Pozzi², G.F. Fraschini², G.M. Peretti^{1,2}

¹Faculty of Exercise Science, University of Milan (Milan-IT);

²Department of Orthopaedics and Traumatology, San Raffaele Scientific Institute (Milan-IT)

Objective Chondrocytes constitute 2% of adult cartilage tissue and are responsible for the maintenance of cartilage architecture: their differentiated phenotype allows them to produce type II collagen and proteoglycans which are required for cartilage functional properties. The possibility of isolating these cells, expanding them *in vitro* and seeding them in scaffolds is one of the approaches for the repair of cartilage lesions. One problem associated with this approach is the de-differentiation of chondrocytes as a result of monolayer culture *in vitro*: in these non physiological conditions they miss important signals, derived from cell to cell contacts and from interaction with extracellular matrix; the result is the loss of expression of important genes, such as type II collagen and aggrecan. They also acquire a fibroblastic-like phenotype characterized by different cell morphology and by expression of non-cartilage specific genes such as type I collagen. We focused on some of the events which affect chondrocytes phenotype *in vitro*: the cell density and the time of the culture.

Material and Methods Swine articular chondrocytes were isolated by enzymatic digestion and seeded at different cell densities (from 12,000 cell/cm² to 100,000 cells/cm²). Samples were cultured for 6 and 8 days. Phenotype was evaluated in terms of aggrecan and collagen type I and II expression, while proliferation was assessed by cell counting.

Results Chondrocytes proliferated more at lower cell densities and did not show any proliferation at highest cell density; moreover, no further proliferation was observed when chondrocytes were kept in culture for 8 days. Cell phenotype was affected both by cell density and by extension of the culture time: chondrocytes seeded at 50,000 and 100,000 cells/cm² were able to maintain a better level of differentiation, characterized by higher expression of type II collagen and aggrecan and lower expression of type I collagen, but in all conditions a significant loss of chondrocyte phenotype from 6 to 8 days of culture was observed.

Discussion Cell density influences chondrocyte capability in maintaining a differentiated phenotype *in vitro* which suggests that some important signals are missing when these cells are cultured in monolayer; however, there is still the need to improve proliferation, which is allowed only at low cell densities, in order to expand chondrocytes. Some other important modulators of proliferation and differentiation, such as growth factors and growth substrates, will be valuated in future studies in order to better modulate proliferation and the loss of phenotype *in vitro*.

“THALASSEMIC BONE”? BONE MINERAL DENSITY (BMD) IN THALASSEMIA INTERMEDIA $\beta^{\text{thal}}/\beta^{\text{thal}}$ AND $\beta^{\text{thal}}/\alpha\alpha\alpha$

A. Amato¹, R. Piscitelli¹, D. Gianni¹, R. Matera¹, A. Scardocci¹, A. Teti²

¹Associazione Nazionale per la lotta contro le Microcitemie in Italia O.N.L.U.S. (Rome-IT), e-mail: microcitemieroma@blod.info;

²Department of Orthopaedics and Traumatology, S. Spirito Hospital, A.S.L.Roma/E (Rome-IT)

Objective Thalassemic patients show important modifications of musculoskeletal system, of which osteoporosis and osteopenia seems to be constant and very important. Bone mineral density strictly correlates with the risk of fracture; the Dual Energy X-ray Absorptiometry (DEXA) is the best non invasive technique in defining and monitoring BMD, thanks to the 99% accuracy and the least ionizing radiations exposure. BMD is abitually estimated through DEXA in the lumbar rachide and femoral neck; osteopenia is defined by values of T-score understood among -1 and -2.5, while values <2.5 define an osteoporotic state. Previous studies demonstrated that the patients with thalassemia intermedia show significant reductions of the BMD; nevertheless, the findings in the literature are conflicting regarding the reduction of the BMD exclusively in lumbar spine or also in femoral neck. Moreover, in literature there are no studies on the correlation between BMD and genotypes of thalassemia intermedia, also in relation to treatment and haemoglobin levels.

Material and Methods This study shows the results of the lumbar and femoral BMDs of two groups of patients, the first one with thalassemia intermedia $\beta^{\text{thal}}/\beta^{\text{thal}}$ and the second one with thalassemia intermedia $\beta^{\text{thal}}/\alpha\alpha\alpha$, in absence of other causes of osteoporosis or osteopenia.

Results and Discussion We have found a prevalence of osteopenia in both the genotypes of thalassemia intermedia, more important in $\beta^{\text{thal}}/\beta^{\text{thal}}$ genotype. In thalassemia intermedia $\beta^{\text{thal}}/\beta^{\text{thal}}$ the BMD reduction is prevalent in lumbar column, while in $\beta^{\text{thal}}/\alpha\alpha\alpha$ genotype it is also observed in femoral neck. Haemoglobin levels and transfusions do not seem to influence the values of BMD.

Conclusions This study shows that the involvement of musculoskeletal system must be valued separately for every genotype. Further studies with data homogeneous for age, sex, haemoglobin levels, therapy, genotype will be essential to clarify if it is possible to speak of “thalassemic bone”, if there are differences of BMD according to the genotype (as it seems to emerge from this study), if the level of haemoglobin and treatment are important, if there is correlation between reduction of the BMD and risk of fractures.

BASIC SCIENCE 2

THE EFFECT OF PLATELET RICH PLASMA ON THE RESTORATION OF ARTICULAR CARTILAGE: AN EXPERIMENTAL STUDY

L. Deriu, V. Izzo, M. Venosa, S. Spinelli, G. Milano, C. Fabbriani

Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT)

Objective To evaluate the effect of Platelet Rich Plasma (PRP) on the treatment of chondral injuries. The hypothesis was that PRP can enhance *in vivo* chondrogenic differentiation of bone marrow stem cells (BMSCs) and cartilage formation after microfractures.

Material and Methods We performed a focal full-thickness lesion of articular cartilage on the weight-bearing area of the medial femoral condyle of the right knee in 15 sheep. Chondral lesions were treated after 12 months. Animals were divided into 3 groups: Group 1, Microfractures; Group 2, Microfractures + PRP hydrogel; Group 3, Microfractures + PRP injection. Animals were sacrificed at 24 weeks. Contralateral knees were used as controls. Gross, biomechanical, and histological analysis were performed. Biomechanical analysis was performed with an electromechanical indenter. Histological appearance was scored according to a modified Mankin's score. Mean cartilage stiffness and histological score were recorded. Comparison between groups was performed with Kruskal-Wallis test, and Tukey's test for pairwise comparisons.

Results In group 1, repair tissue partially covered the defect; in groups 2 and 3 the defect was completely covered, but in group 3, it was less regular and consistent. Mean cartilage stiffness of group 2 approximated that of controls. Groups 1 and 3 showed a significantly lower stiffness. At histology, in group 1, repair tissue consisted of a thin layer of fibrous tissue with chondrocytes-like cells in a fibrous and poorly organized ECM and showed an intense safranin-O staining. In group 2, the defect was almost completely covered; repair tissue showed a rich cellularity, an intense safranin-O staining of ECM, and a good integration with the healthy cartilage. Numerous clusters of chondrocyte-like cells were found in the transitional and radial zones and some clefts deepened to the radial zone. Tidemark was observed in some areas. In group 3, a thin layer of repair tissue covered almost completely the defect, showing an intense safranin-O staining, a great amount of cells well-organized in columns in the transitional zone and rare clusters in the deep zone. Tidemark was absent. Histological scoring was significantly lower in all groups in comparison with normal cartilage, but the score of group 2 was greater than group 1 and 3, although the only significant difference was observed between group 1 and 2.

Conclusions PRP showed a positive effect on cartilage repair and restoration after microfractures. The procedure was more effective when PRP was used as a hydrogel scaffold in comparison with liquid intrarticular injection.

EFFECT OF PLATELET RICH PLASMA ON BONE HEALING AFTER HIGH TIBIAL OSTEOTOMY: AN ANIMAL STUDY

V. Izzo, L. Deriu, M. Venosa, S. Spinelli, G. Milano, C. Fabbriani

Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT)

Objective To evaluate the effect of Platelet Rich Plasma (PRP) in increasing and accelerating bone healing and integration of bone graft after high tibial osteotomy.

Material and Methods Twenty adult sheep underwent a medial opening-wedge high tibial osteotomy. Fixation was achieved using a purposely modified Puddu's plate. Animals were divided into 2 groups. In group 1 the bone defect at the site of osteotomy was filled with cancellous bone harvested from iliac crest; in group 2 the defect was filled with autogenous bone graft and PRP derived from autologous blood. No immobilization was used after surgery. Animals were sacrificed at 4 and 8 weeks. Contralateral knees were used as controls. Biomechanical and radiographic evaluation were performed on each sample. On biomechanical compression test, we recorded ultimate load, yield load, axial stiffness in the elastic region, displacement at 250, 500, 750, 1000 N, and mode of failure. Radiographic appearance was scored according to An's classification. Comparisons between different time intervals within each group were carried out with Wilcoxon rank sum test; comparisons between groups at each time interval were carried out with Mann-Whitney *U*-test; analysis of variance between groups at each time interval was carried out with Kruskal-Wallis test; post-hoc analysis for multiple paired comparisons was carried out with Tukey's test. Significance was set at $p < 0.05$.

Results Radiographic score at 8 weeks was significantly greater than that at 4 weeks in both groups. Group 2 showed mean score significantly greater than group 1 at each time interval. At mechanical testing, mean ultimate load and yield load of group 1 were significantly lower than those of group 2 and control group at each time interval. At 8 weeks, group 2 showed mean ultimate load and yield load significantly greater than control group. Mean axial stiffness of group 2 was significantly greater than group 1 and control

group at each time interval. Mean displacement of group 2 was significantly lower than group 1, but significantly greater than control group at each time interval. At 4 weeks, failure always occurred mainly in the area surrounding osteotomy in both groups. At 8 weeks, failure mostly occurred in the diaphysis in both groups.

Conclusions PRP had a significant accelerating effect on early healing of autogenous bone graft used for filling the defect in opening-wedge HTO. Autogenous bone graft was significantly stronger and stiffer when used in combination with PRP.

BONDING OF MENISCAL TISSUE WITH CELLULAR FIBRIN GLUE: A NUDE MOUSE STUDY

C. Scotti^{1,2}, L. Mangiavini¹, A. Pozzi¹, F. Vitari³, C. Domeneghini³, G. Frascini¹, G.M. Peretti^{1,4}

¹San Raffaele Scientific Institute (Milan-IT); ²Residency Program in Orthopaedics and Traumatology I, University of Milan (Milan-IT); ³Department of Veterinary Sciences and Technologies for Food Safety, Faculty of Veterinary Medicine, University of Milan (Milan-IT); ⁴Faculty of Exercise Sciences, University of Milan (Milan-IT)

Objective Menisci play a fundamental role in knee biomechanics, but they lack intrinsic regenerative properties. Consequently, when a tear occurs and the meniscus is removed surgically, even partially, crucial changes in knee homeostasis take place, often leading to the development of early osteoarthritis. The aim of this study is to assess the capacity of isolated chondrocytes embedded in fibrin glue to promote bonding of meniscal slices in a nude mice model. **Material and Methods** A swine chondrocytes-fibrin glue suspension was utilized as a biologic glue to improve bonding between two meniscal slices obtained from swine menisci. Tissue engineered tri-phasic sandwiches were obtained combining two meniscal slices with cellular fibrin glue and then wrapped with acellular fibrin glue. We prepared also control samples with acellular fibrin glue between the meniscal slices in order to evaluate the role of cells in the bonding process. All samples were wrapped in an acellular fibrin gel and then implanted in the subcutaneous tissue of nude mice for four weeks.

Results At the end of the fourth week from implantation, samples were retrieved, macroscopically analyzed, tested for gross bonding and processed for histological evaluation. The fibrin glue embedding the samples was almost absorbed and the remnants appeared reorganized into a neo-capsule wrapping each sample, rich of neovessels. Moreover, the meniscal slices did not show any shrinkage or signs of digestion demonstrating the effectiveness of the fibrin gel embedding as a "shield" against metalloproteinases digestion, while the fibrin gel itself appeared rich of cells likely deriving from the host animal. The gross bonding between the meniscal slices was tested with a pair of forceps and demonstrated a firm adhesion between the two slices in all the experimental samples. On the other hand, none of the control samples showed any sign of bonding. Histological evaluation (H&E) demonstrated the presence of a hypercellular fibrocartilaginous tissue at the interface between the slices. Interestingly, some penetration buds were present inside the meniscal slices coming from the cellular fibrin gel. No penetration buds and no cellular tissue were found in the control samples. SEM confirmed the presence of a continuous tissue in the interface between the meniscal slices in the experimental samples.

Discussion These results demonstrated the potential of this model for improving meniscal bonding and confirmed the importance of cells in the bonding process of tissues. However, further orthotopic studies in a large animal model are needed to evaluate its feasibility in clinical practice.

Suggested readings

1. Peretti GM, Gill TJ, Xu JW, Randolph MA, Morse KR, Zaleske DJ (2004) Cell-based therapy for meniscal repair: a large animal study. *Am J Sports Med* 32(1):146–158
2. Peretti GM, Xu JW, Bonassar LJ, Kirchhoff CH, Yaremchuk MJ, Randolph MA (2006) Review of injectable cartilage engineering using fibrin gel in mice and swine models. *Tissue Eng* 12(5):1151–1168
3. Peretti GM, Zaporozhan V, Spangenberg KM, Randolph MA, Fellers J, Bonassar LJ (2003) Cell-based bonding of articular cartilage: An extended study. *J Biomed Mater Res A* 1:64(3):517–524

EXPERIMENTAL AND CLINICAL EMPLOYMENT OF END-TO-SIDE COAPTATION FOR IRREPARABLE NERVE LESIONS: OUR EXPERIENCE

P. Tos¹, S. Geuna², S. Raimondo², I. Papalia³, L.G. Conforti¹, S. Artiaio¹, B. Battiston¹

¹Unità di Microchirurgia Ricostruttiva, Dipartimento di Ortopedia e Traumatologia, Ospedale CTO (Turin-IT), e-mail: pierluigi.tos@unito.it; ²Dipartimento di Scienze Cliniche e Biologiche, Università di Torino (Turin-IT); ³Dipartimento delle Specialità Chirurgiche, Università di Messina (Messina-IT)

Objective The last fifteen years have seen a growing interest regarding a technique for nerve repair named end-to-side (ETS) coaptation. Since 2000, we have carried out experimental studies on ETS nerve repair as well as employed this technique to a series of selected clinical cases. Here we report the results of these studies.

Material and Methods For experimental studies, we have used the model represented by median nerve repair by ETS coaptation either on the ulnar (agonistic) or the radial (antagonistic) nerve. For time course assessment of median nerve functional recovery we used the grasping test, which permits to assess voluntary control of muscle function. Repaired nerves were processed for resin embedding to allow nerve fiber stereology and electron microscopy.

Results Results showed that, in either experimental group, ETS-repaired median nerves were repopulated by axons regenerating from ulnar and radial donor nerves respectively. Moreover, contrary to previously published data, our results showed that voluntary motor control of the muscles innervated by the median nerve was progressively recovered also when the antagonist radial nerve was the donor nerve. As regards our clinical experience, results were not so positive. We have treated by ETS coaptation patients with both sensory ($n = 7$: all S3+ - 2PD 7–15 mm) and mixed ($n = 8$ - plexus level) nerve lesions. Results were good, as in other series, in sensory nerves but very difficult to investigate in mixed nerves at the plexus level.

Discussion and Conclusions Take together, these results suggest that clinical employment of ETS coaptation should be still considered as the *ultima ratio* in cases in which no other repair technique can be attempted. Yet, it is clear that more basic research is needed to explain the reasons for the different results between laboratory animal and humans and, especially, to find out how to ameliorate the outcome of ETS nerve repair by adequate treatment and rehabilitation.

Suggested readings

1. Battiston B, Tos P, Conforti LG, Geuna S (2007) Alternative techniques for peripheral nerve repair: conduits and end-to-side neurorrhaphy. *Acta Neurochir Suppl* 100:43–50
2. Papalia I, Cardaci A, Stagno D'alcontres F, Lee JM, Tos P, Geuna S (2007) Selection of the donor nerve for end-to-side neurorrhaphy. *J Neurosurg* 107:378–382

3. Papalia I, Geuna S, D'Alcontres FS, Tos P (2007) Origin and history of end-to-side neurorrhaphy. *Microsurgery* 27(1):56–61

MECHANO-TRANSDUCTION TO CELL INTERFACE IN THE MUSCULOSKELETAL TISSUES EXPOSED TO SHOCK WAVE TREATMENT

S. Russo, E.M. Corrado, C. Servodio Iammarrone, E. Astarita

Department of Surgery, Orthopaedics, Traumatology and Emergencies, University of Naples "Federico II" (Naples-IT)

The authors explain the most recent acquisitions in the comprehension of the mechanisms of action of shock waves. This research aims to clarify the innermost mechanisms which, on a cellular level, lead to decoding a physical sign (energy) into a biochemical and biological sign.

On a cellular level the mechanical pulse of shock wave changes into a membrane signal which in turn brings about a cascade of events. The first of these events is the activation of a nitric oxide (NO) synthesis with production of NO, from which arise: (1) a re-balancing of respective levels of inducible NO (iNO) and endothelial NO (eNO); (2) a neo-angiogenic response; (3) a differential stimulus tissue specific of resident cell precursors. The series of events thus summarized explains a biochemical/metabolic effect which clarifies the regenerative mechanism of shock waves both in case of pseudarthrosis and of bone necrosis, stage I and II of the ARCO classification.

Suggested readings

1. Delius M (1995) Biological effects of shock waves. In vivo effects of high energy pulses on rabbit bone. *Ultrasound Med Biol* 21:1219ff
2. Delius M, Ueberle F, Eisenmenger W (1998) Extracorporeal shock waves act by shock wave-gas bubble interaction. *Ultrasound Med Biol* 24:1055–1059
3. Mariotto S, Cavalieri E, Amelio E, Ciampa A, Marlinghaus E, Russo S, Suzuki H (2005) Extracorporeal shock waves: from lithotripsy to anti-inflammatory action by NO production. *Nitric Oxide* 12:89–96
4. Gotte G, Amelio E, Russo S, Marlinghaus E, Musci G, Suzuki H (2002) Short-time non-enzymatic nitric oxide synthesis from L-Arginine and hydrogen peroxide induced by shock waves treatment. *FEBS Letters* 520:153–155
5. Hagelauer U, Russo S, Gigliotti S, de Durante C, Corrado EM (2001) Interactive Navigation System for Shock Wave Applications. *Computer Aided Surgery* 6:22–31

BIOCOMPATIBILITY OF UHMWPE DOPED WITH VITAMIN E (α -TOCOFEROL) IN AN ANIMAL MODEL: AN EXPERIMENTAL STUDY IN RABBITS

F. Conteduca, C. Rossi, F. D'Angelo, A. Ferretti

Orthopaedic Unit and "Kirk Kilgour" Sports Injury Center, St. Andrea Hospital, II School of Medicine, "La Sapienza" University of Rome (Rome-IT)

Objective Ultra-high molecular weight polyethylene (UHMWPE) is a biocompatible polymeric material, used in prosthetic components. Wear and fatigue damage of UHMWPE are considered as the major responsible for long-term implant failure. Although the cross-linking process has been shown to be effective in reducing wear and debris generation, it also initiates the oxidative degradation while post-irradiation melting modifies the chemical-physical

structure of the UHMWPE, compromising some of the mechanical properties of the material. Thus a second-generation of highly cross-linked polyethylene stabilized with Vitamin E was proposed in order to slow the oxidative degradation and preserve polyethylene mechanical properties. The aim of this study is to evaluate the biocompatibility of UHMWPE "doped" Vitamin E in an animal model, the rabbit.

Material and Methods Thin disks of conventional and "doped" UHMWPE (with 15 wt% α -tocopherol added) were machined and then implanted under the patellar articular surface of 20 female 6-month-old Giant rabbits, weighing about 5 kg. Macroscopic and histopathologic analyses were carried out after 12 months.

Results In the anterior cavity of both sets of samples, micromechanical stresses induced a fibro-osseous tissue ingrowth surrounding the implant, bone remodeling of the articular surfaces as well as loss of definition of the quadriceps and patellar tendons. Macroscopic analyses also showed enlargement of the posterior cavity in both groups. In all sets of samples histological analyses showed papillary proliferation of synovial tissue, giant-cell presence and neovascularization, due to an inflammatory response of synovial tissue to polyethylene particulate debris.

Conclusions Our findings showed that tissue reaction to conventional UHMWPE and α -tocopherol-doped UHMWPE were not significantly different, suggesting that the observed modifications were a reaction to UHMWPE, whereas the addition of vitamin E had no influence on them. Several laboratory studies have already showed that "doped" UHMWPE has wear and fatigue resistance higher than conventional UHMWPE. Our results indicate that the addition of vitamin E did not adversely affect the bioactivity of UHMWPE, confirming its suitability as a stabilizer for UHMWPE.

TUMOURS

TREATMENT OF IMPENDING FRACTURES FROM BONE METASTASES OF THE LOWER PART OF THE HUMERUS

G. Grecomoro, L. Nalbone, A. Macaione, R. Lentini

Clinica Ortopedica, Università di Palermo (Palermo-IT)

"By impending fractures we mean simple or mixed bone lesions characterized by the interruption of the cortex by 50% of bone diameter with persistent pain in spite of chemo- and radio-therapy" (Campanacci et al., 1999). These metastatic lesions are rare and the aim of the treatment is to improve the prognosis and the quality of life, allowing a rapid mobilization of the elbow, avoiding stiffness, eliminating pain and preventing pathological fractures. In the treatment of this pathology in the Orthopaedic Clinic of Palermo University we follow faithfully Prof. Campanacci's protocol (Campanacci N 13 April '99). The position of the metastasis in the lower part of the humerus will determine the surgical treatment that reserves prosthetic substitution for those cases in which the tumor is in the epiphysis and eventually extends to the neighbouring soft tissues, while the metaphyseal region is treated with curettage, a double-plate means of synthesis and the application of cement (reinforced osteosynthesis). Since January 2006 up to now we have treated 5 cases of metastatic tumor of the lower part of the humerus, of which one was in the epiphysis spreading to the surrounding soft tissues and two in the metaphysis characterized by an interruption in the cortex involving more than 50% of the bone diameter. In 2 cases it was a single plasmocytoma metastatic, while the other one was a multiple metastasis originating from renal carcinoma (lower femur lower humerus and 3 lumbar vertebrae). In the epiphyseal case we used a Kotz modular, cemented prosthesis, with dorsal surgical access to the elbow according to Alonso L. Iames (a

technique that maintains the continuity of the triceps tendon) while in the other 2 cases we preferred the wider Campbell access, using in one case 2 angular stabilizing plates O'Driscoll plus cement and in the other 2 plates including O'Neil's medial one and the posterolateral one with cement. The patients began to move their elbows actively on the third day and within a month excellent functionality was achieved. The patient with multiple metastases died four months later but he was self-sufficient, almost up to the end. After 2 years the other two are carrying out their daily activities without problems and with excellent functionality.

PROSTHETIC RECONSTRUCTION OF THE HUMERUS AFTER RESECTION OF PRIMARY TUMORS: EXPERIENCE OF THE ISTITUTO RIZZOLI IN 277 CASES

P. Ruggieri, T. Calabrò, M. Montalti, E. Pala, G. Bosco, A. Ferraro, M. Mercuri

Department of Orthopaedics, Istituto Ortopedico Rizzoli, University of Bologna (Bologna-IT)

Material and Methods Between 1974 and 2006, 277 patients had prosthetic reconstruction of the humerus after tumor resection. These included 253 reconstructions of the proximal humerus: 225 cemented modular prostheses, 18 uncemented modular prostheses, 9 allograft/prostheses composites, 1 custom-made prosthesis; 2 diaphyseal reconstruction: 1 intercalary prosthesis and 1 MRS; 13 reconstructions of the distal humerus: 11 uncemented modular prostheses, 1 allograft/prosthesis, 1 Coonrad-Morrey prosthesis; 9 total humerus reconstructions: 6 uncemented modular prostheses, 2 allograft/prostheses composites, 1 custom made prosthesis. The uncemented modular prosthesis used was the HMRS® Stryker and the cemented modular was the MRS® Bioimpianti. Histologically, 24 were benign tumors and 253 primary malignant tumors. All patients were periodically followed in the clinic, imaging studies and histology were reviewed and special attention given to prostheses-related complications and implant survival. Univariate analysis through actuarial Kaplan Meier curves was used in evaluating implant survival to major complications. Functional results were assessed using the MSTs system.

Results At a medium follow-up of 9 years 121 patients were NED, 14 NED1pm, 7 NED1lr, 1 NED1bm, 3 NED2pm, 2 NED2lr, 1 NED3pm, 102 died of disease, 19 died of other disease, 7 were lost to follow-up. Major complications of the implants included 19 cases of deep infection (6.8%), 8 aseptic loosening (2.9%), 4 breakages (1.4%) causing failure of the implants requiring revisions. Further complications were observed in revised cases. Actuarial curve of implant survival to major complications showed over 80% at 10 years and over 70% at 20 years. Functional results according to the MSTs system were good or excellent (over 50%) in over 90% of the patients, with an average score of 79%.

Discussion Osteoarticular allografts have been reported to yield superior functional results than prosthetic reconstruction in proximal humerus, although also this technique implies a remarkable incidence of complications. Recent reports show equally satisfactory results with prostheses. The different surgical indications depend on possibility of sparing the deltoid muscle, the axillary nerve and the rotator cuff, which is related with the site and extension of the tumor. Whenever these structures can be salvaged, reconstruction with osteoarticular allograft or allograft/prosthesis composite is a better option. For most of the high grade bone sarcomas of the shoulder salvage of these abductor structures is not feasible and safe.

Conclusions Different techniques are available in reconstructions of the humerus after tumor resection, the indications depending on type of resection and removal of soft tissues required.

THE USE OF THE CEMENT FOR BONE RECONSTRUCTION IN ONCOLOGICAL BONE SURGERY OF LOWER LIMB

F. Pezzillo, F. Liuzza, T. Nizgorodcew, G. Gosheger, G. Maccauro

Dipartimento di Scienze Ortopediche e Traumatologia, UCSC, Policlinico A. Gemelli (Rome-IT)

Introduction In the literature cement is currently used for filling bone defect after curettage in bone oncology. It is well known the possibility of bone cement to give mechanical resistance to involved segment and to evaluate early tumor recurrence. We describe two cases of oncological bone reconstruction using cement and plate or cement and intramedullary nail.

Case 1 (Distal femoral parosteal osteosarcoma). Parosteal osteosarcoma is a low-grade malignant bone tumor arising from the distal femur and tibia. Wide resection of a parosteal osteosarcoma usually prevents local recurrence. In literature are described hemicortical resections of low-grade malignant bone tumors and allograft reconstruction. We describe a new method of resection and reconstruction of parosteal osteosarcoma located in the popliteal parosseous space of the distal part of the femur using cement and plate (LISS-SYNTHES) through dual medial and lateral incisions. We think that this is a new valid and alternative technique when is not possible use allograft and to prevent allograft complications such as fractures. In our technique the femoral articular surface is saved, the joint remains stable and the knee function is good 1 year after the surgery. In presence of complication bone resection and reconstruction with tumoral prostheses should be considered. The patient did not present infections and fractures and the functional results were good. After one year no metastases developed and there were no local recurrences.

Case 2 (Distal tibial Malignant Fibrous Histiocytoma). A 50-year-old male who complained for distal tibia swelling, pain and functional impairment for 2 months. X-ray showed osteolysis along medial cortex of distal tibia. MRI showed the modification of distal bone tibia without joint involvement. Incisional biopsy revealed the presence of Malignant Fibrous Histiocytoma. Surgical strategy: wide margin bone resection; reconstruction with locked nail inserted in a static mode, filling the cavity with PMMA and soft tissue coverage with abdominal microvascularized graft. Postoperative radiotherapy was performed. Four years after surgery, the patient walks with a brace but without cane. No sign of recurrence or metastasis is present. This technique is a good alternative to amputation or prosthesis in case of primary malignant bone tumors. We think that the use of cement is a valid and alternative technique when is not possible use allograft or prostheses and to prevent complications such as loosening, infections, subsidence, instability and loss of function in case of prostheses or fractures in case of allograft.

THE TREATMENT OF SOFT TISSUE SARCOMAS OF THE LIMB: THE EXPERIENCE OF THE ISTITUTO RIZZOLI IN 1944 CASES TREATED OVER THE LAST TWO DECADES

A. Ferraro, P. Ruggieri, M. Gigli, M. Montalti, A. Toscano, S. Ferrari, E. Barbieri, M. Mercuri

Department of Orthopaedics and Department of Radiotherapy, Istituto Ortopedico Rizzoli, University of Bologna (Bologna-IT); Department of Chemotherapy, Istituto Ortopedico Rizzoli (Bologna-IT)

Aims Soft tissue sarcomas (STS) are rare tumors often misdiagnosed and mistreated. Several prognostic factors have been report-

ed and grade, size and site focused as preminent. A multimodal approach with integration of surgery, chemotherapy and radiotherapy is more recently recommended. Aim of this study was to review the experience of the Istituto Rizzoli, in order to try to define the current more appropriate operative guidelines.

Material and Methods Between 1982 and 2003, 1944 patients with STS of the limbs were treated: 430 consultation cases and 1514 inpatients were analyzed. Of these 1514 patients, 1444 had surgery, while 70 did not. Surgery was conservative in 966 cases and demolitive in 269; 208 patients had wide excision of the wound after inadequate surgery. Patients were clinically followed, imaging studies and histology were reviewed and special attention given to the assessment of response to treatment and incidence of local recurrence.

Results The overall local recurrence rate was 21%, namely 16% in adequate margins and 45% in inadequate margins. Local recurrences were related with a higher mortality and a higher incidence of metastases in the reported series. Of the 966 patients that had conservative surgery, in 107 (11%) excision included bone, vessels or adjacent joint in order to obtain an adequate margin. Defects were reconstructed with bone allografts, modular prostheses and vascular by-passes. Furthermore different techniques of soft tissue reconstructions were associated when needed. Preoperative radiotherapy was usually reserved to large size sarcomas, especially with myxoid component. Adjuvant postoperative chemotherapy was introduced at the end of the eighties and used for some histotypes until 2000. Due to the apparently good results observed with chemotherapy, a multicentric study was started using neoadjuvant chemotherapy in 2000. At the Rizzoli 91 patients were enrolled in this study.

Discussion Observation of a higher incidence of distant metastases and a higher mortality have been described in several reported series in the literature, although there is not absolute agreement on the adverse prognostic role of local recurrences. The association of radiotherapy clearly improves local control for high grade sarcomas deeply located and greater than 5 cm volume. The role of adjuvant chemotherapy is well established in improving prognosis, whereas neoadjuvant chemotherapy did not show up to now definite advantages toward adjuvant chemotherapy.

Conclusions Multimodal approach is recommended in the treatment of STS of the extremities, although clear advantages of neoadjuvant *versus* adjuvant chemotherapy are not documented.

SURGICAL TREATMENT OF THE TUMORS OF THE THIRD DISTAL FIBULA

V. Prezioso, B. Rossi, L. Messuti, F. Visci, G. Maccauro

Department of Orthopaedics and Traumatology, Catholic University (Rome-IT)

Distal fibula is a very unusual localization of primary neoplasm and metastasis, being its incidence in only 2.4% of primary bone tumors. On the contrary tumors located at proximal third of the fibula are more frequent.

Primary bone tumors of distal fibula affect mainly young patients without prevalence of sex; complexity of the anatomical region and importance of functional third distal fibula in the ankle joint induces some debates in the therapeutic options of such disease.

Usually lesions affecting the distal III of the fibula are benign or tumoral-like, and therapeutic options are mostly periodic observations; surgery and especially bone resection may induce some functional issues, and therefore is indicated in the presence of persistent pain, traumatic complications or doubts of malignancy. Surgery is indicated in these injuries for functional issues that the resection of the distal fibula may entail.

Authors report their cases of neoplastic lesions of the third distal fibula treated surgically at the Department of Orthopaedics and Traumatology between 2002 and 2007. Seven tumors of third distal fibula were treated; most of these lesions were benign or tumoral-like, in a single case was diagnosed a metastasis of lung adenocarcinoma. Authors discuss the diagnostic process of these lesions and different therapeutic methods used such as curettage, resection, and the various options for filling the remaining cavity (substitutes bone or acrylic cement). Authors underline how resection of the distal fibula requires 5 cm fibula residue for a good function of ankle joint.

THE ROLE OF SURGERY IN VERTEBRAL LOCALIZATION OF MULTIPLE MYELOMA

S. Paderni, M. Cappuccio, A. Gasbarrini, S. Bandiera, L. Amendola, S. Boriani

Department of Orthopaedics and Traumatology – Spine Surgery, Maggiore Hospital (Bologna-IT)

The clinical outcome in patients surgically treated for multiple myeloma of the spine has not been intensively studied. Because patients with myeloma often live longer than patients with bone metastases from other malignancies, it is important that these patients be examined and treated with methods specific to their needs and not only with those typically used for patients with metastatic disease.

We report on the clinical course of 62 consecutive patients surgically treated for solitary or multiple myeloma of the spine. To evaluate the complications, neurologic functions, life quality, and survival after decompression of the spinal cord and stabilization of the spinal column in cases of conventionally untreatable pain, neurologic impairment, or spinal instability.

MININVASIVE TREATMENT OF FOOT OSTEOID OSTEOMAS WITH RADIOFREQUENCY THERMOABLATION

P. Caldora¹, P. De Biase², D. Campanacci², D. Lup¹, R. Guarracino¹, R. Capanna²

¹U.O. Ortopedia e Traumatologia, Ospedale S. Margherita Valdichiana (Cortona-IT); ²S.O.D. Ortopedia Oncologica, Azienda Ospedaliera Universitaria Careggi, C.T.O. (Florence-IT)

Introduction Osteoid osteoma represents the most frequent benign foot tumour. Up to about 10 years ago the conventional treatment was its surgical removal, but this operation is long and frequently causes complications. Radiofrequency thermoablation is by now a largely accepted technique and it is an efficacious alternative to surgery.

Material and Methods From 1999 to 2007 we treated 21 patients suffering from foot osteoid osteoma. The affected bones were respectively the astragalus in 13 cases, metatarsals in 5 cases and the heel, the cuboid and a phalanx all in 1 case. The diagnosis was made taking into account pain, which occurs mainly by night and disappears with aspirin, and X-ray, C.T. and bone scintigraphy images. All the patients underwent thermoablation under C.T. control, with a 1-cm long probe and both computerized dynamic control of temperature and the impedance of the area under treatment. The average temperature during the procedure was 90°C with an average time of five minutes for the thermoablation. In all the cases a control C.T. was made at the end of the treatment and a control MR a month after the surgery.

Results At an average 25-month follow-up (min 4 months, max 110 months) 20/21 patients (95%) fully recovered, there was only one

failure (5%). This was actually a diagnosis mistake as the image simulating the osteoid osteoma was a reactive ossification caused by ankle anterior impingement. In all the cases the MR made after a month always showed a clear reduction of the edema round the injury. Neither complications nor recidivism were detected.

Conclusions The miniminvasive percutaneous treatment of foot osteoid osteomas represents the elective method of treatment with a 95% rate of recovery without any complications as our experience shows.

CLINICAL EXPERIENCE ABOUT STACKABLE CARBON-FIBER PROSTHETIC REPLACEMENT OF VERTEBRAL BODIES (115 IMPLANTS IN 114 PATIENTS)

S. Boriani¹, S. Bandiera¹, F. De Iure¹, A. Gasbarrini¹, M. Cappuccio¹, R. Biagini²

¹Department of Orthopaedics and Traumatology – Spine Surgery, Maggiore Hospital (Bologna-IT); ²Istituto Regina Elena, IFO (Rome-IT)

Long term survival can be expected in bone tumors of the spine when submitted to appropriate surgical and oncologic treatment: the replacement of a vertebral body in these selected cases must be performed aiming to achieve immediate recovery of function as well as a solid fusion for long term stabilization.

The results are presented of a retrospective study on 115 carbon-fiber prostheses implanted for anterior column replacement after corpectomy or vertebrectomy performed for the treatment of bone tumors of the spine. These prostheses were assembled intraoperatively by combining stackable cages according to the required length, filled with autologous bone chips and connected with posterior and/or anterior instrumentation.

RPS-LIMA: AN ITALIAN SYSTEM FOR SKELETAL METASTASES

V. Ippolito, L. Ianni, M. Paderno

Centro di Oncologia Ortopedica, Spedali Civili (Brescia-IT)

Skeletal metastases represent the most frequent malignancy of the skeletal system: they are 40 times more frequent than primary tumors. Proximal femur and proximal humerus are the anatomic sites which most frequently require surgical treatment and very often, for biomechanical, biological and prognostic reasons, resection is the best treatment. Cost containment, which is now a worldwide necessity, makes it impractical to use the high-cost prostheses designed for primary tumors in this group of patients with a poor prognosis; we well know that, for the biology of the underlying disease, 50% of these patients will not survive over 18 months. It's very important, therefore, to have a system which is able to solve the problems of these patients at an acceptable cost.

The RPS System includes prostheses for the proximal femur and proximal humerus and has all the features which make it optimal for this group of diseases: it's a modular system, made of Titanium (excellent mechanical features and biocompatibility), cemented (very important in these patients), and has an acceptable price-tag. Technological quality is very high (it's FDA approved) and has all the features which are essential for the necessities of these patients. Starting in 1984, we have implanted 200 RPS (160 proximal femurs and 40 proximal humerus): the results are perfectly adequate for the needs of these patients. In some particular cases they have been used also for patients with primary tumors and a poor prognosis or to "salvage" non-oncologic problems.

In our experience, this system (which is now reaching the 3rd generation) represents an invaluable tool for the treatment of poor-prognosis patients.

PEDIATRIC ORTHOPAEDICS

THE EFFECTIVENESS OF TWO DIFFERENT DEVICES IN MANAGEMENT OF DEVELOPMENTAL DYSPLASIA OF THE HIP

R. Azzoni

Clinica Ortopedica, Università degli Studi (Milan-IT)

Aim During 15 years we studied by sonography over 25,000 hips in infants for the screening of DDH, staging by the Graf's classification that is useful for the management of dysplasia too. The goal of the study is the evaluation of effectiveness of both the harnesses in management of DDH.

Methods From January 2001 to December 2003, in 118 DDH, we employed, in a blinded randomised study, two different devices: Teuffel Mignon, which allows placing hips in controlled abduction of about 60° (59 hips), and Coxa-Flex device, which allows placing hips in flexion of 90°–100° and abduction of about 50° (59 hips). In this study we checked 51 hips type IIC (31 TM and 20 CF device); 43 type IID (20 TM and 23 CF device); 15 type IIIA (5 TM and 10 CF device); 9 type IIIB (3 TM and 6 CF device).

Results Hips Graf's type C recovered on average in 60.09 days, with TM in 50 days, with CF in 63.45 days. Hips type D recovered on average in 100 days, with TM in 58.50 days, with CF in 89.00 days. Hips type IIIA recovered on average in 103.60 days, with TM in 122 days, with CF in 94.50 days. Hips type IIIB recovered on average in 108.66 days, with TM in 121 days, with CF in 102.50 days. The linear multiple regression model shows a statistically significant association between outcome and pathological type ($p < 0.001$), age at diagnosis ($p < 0.001$) and device ($p < 0.02$). The statistical model shows that on average for each day of delay in the diagnosis is needed more than half a day for the patient to recover. The model confirmed that patients with more serious pathologies need a longer time to recover.

Discussion and Conclusions During this study we did not observe any difference in the outcome between the two devices. We think that the importance of the treatment of DDH is not only the type of device employed, but a precise and correct sonographic diagnosis with Graf's method. It is very important starting the treatment as soon as possible, when the infant's bone of the hip is more plastic and easy to treat. It is also statistically estimated that the time of recovery has not a precise relation with the age at diagnosis. Our opinion is that the choice of the right device is fundamental and can be only derived from a great clinical experience in the treatment of this pathology.

NERVE REPAIR BY TUBULIZATION IN CHILDREN

F.M. Sénès, N. Catena

Orthopaedics and Traumatology Unit, G. Gaslini Scientific Institute (Genoa-IT)

Introduction Traumatic peripheral nerve injuries in the upper or lower limbs are a common event during developmental age, however few exclusively paediatric case series have been reported in the literature. The methods of repair of nerve injury in children are similar to those used in adults, but the small size of the nerves often

make it difficult to find appropriate nervous tissue to repair of such injuries. The aesthetic damage to the area of donor site for nerve graft is a heavy problem for the family. Aim of this study is to report our experience in nerve repair through synthetic tubulization in paediatric patients.

Material and Methods We considered 8 patients treated at the Orthopaedics and Traumatology Unit of G. Gaslini Institute in Genoa from 2005 to 2007. Seven cases presented traumatic injuries (4 obstetric brachial plexus palsy, 1 cutting injury of peroneal nerve, 1 post traumatic closed injury of radial nerve, 1 shotgun injury of sciatic nerve) and 1 case neoplastic lesion (malignant schwannoma) of brachial plexus. All patients underwent pre-operatively clinical evaluation, electromyography, nerve conduction velocity, ultrasound and MRI study. In all cases, the lesion was repaired using synthetic tube (Neuragen®) alone or in addition to nerve grafts. In cases of peripheral nerve injury, after identification of stumps and resection of neuroma, the two nerve ends were connected by interposition of synthetic tube, fixed with microsurgical suture. In patients with obstetric brachial plexus palsy, repair was carried out using a tube from C5–C6 roots to the superior trunk in 2 cases, a tube from C5–C6 to the superior trunk, a tube from C7 to the middle trunk and a tube from C8–T1 to the inferior trunk in 1 case, and a single tube from C5 (the only healthy root available) to superior, middle and inferior trunks in 1 case. In these cases, repair was completed with neurotization.

Results These results are still incomplete and the follow-up is limited. The use of tube for nerve repair in children has shown initial signs of clinical and electrophysiological recovery that substantially overlap those observed with traditional methods, but they cannot be considered as definitive since a longer follow-up is required. However this technique represents a significant opportunity to find additional tissue for nerve repair in children.

Conclusions The use of tubulization for peripheral nerve reconstruction in childhood could be very useful in case of extensive nerve injury, since it increases available material for repair or can even represent an alternative to nerve grafts. The impossibility of finding in the child peripheral veins appropriate in size for creation of biological tube leads to the use of synthetic tube. The advantages of this solution in undoubtedly the opportunity of saving autologous structures with the advantage of avoiding morbidity at the donor site, while its disadvantage is only represented by the cost of synthetic tube.

Suggested readings

1. Terzis JK et al (2007) Vein grafts used as nerve conduits for obstetrical brachial plexus palsy reconstruction. *Plast Reconstr Surg* 120(7):1930–1941
2. Ashley WW et al (2006) Collagen nerve guides for surgical repair of brachial plexus birth injury. *J Neurosurg* 105[Suppl 6]:452–456
3. Chang HM et al (2008) Melatonin preserves superoxide dismutase activity in hypoglossal motoneurons of adult rats following peripheral nerve injury. *J Pineal Res* 4:172–180
4. Battiston B et al (2005) Nerve repair by means of tubulization: literature review and personal clinical experience comparing biological and synthetic conduits for sensory nerve repair. *Microsurgery* 25(4):258–267

THE MODIFIED GALEAZZI TECHNIQUE FOR THE TREATMENT OF PATELLAR INSTABILITY IN YOUNG PATIENTS

V. Guzzanti¹, M. Giordano², A.G. Aulisa², G. Mastantuoni²

¹University of Cassino (Cassino-IT); ²Institute of Scientific Research, "Bambino Gesù" Children's Hospital (Rome-IT)

Objective The patello-femoral malalignment is a frequent condition in young patients and can be associated with patellar instability. Many surgical procedures have been described for patellar instability treatment, but only a realignment through soft tissue balancing has been used in young patients [1–3]. Having acquired experience in Galeazzi surgical technique, we present our results concerning treated patients.

Material and Methods We treated 40 preadolescents and adolescent with patello-femoral malalignment studied by pre-operative static-dynamic CT scans. All patients referred one or more patellar dislocation. A surgical approach with modified Galeazzi technique was performed in all cases. The surgical procedure is characterized by tenodesis of the semitendinosus and lateral release; an augmentation with a medial capsular ritention was performed in some cases. The semitendinosus tendon crosses in a oblique patellar tunnel (5-mm size) from infero-medial to supero-lateral, in order to center the patella.

Results The results at follow-up showed: (1) no patellar growth disturbances; (2) regression of instability; (3) a normal patello-femoral alignment evaluated with TC scans, with the exception of two cases; (4) no functional limitations.

Conclusions The modified Galeazzi procedure is a valid surgical solution for the treatment of patellar instability in preadolescents and adolescents. The tenodesis performed with semitendinosus is effective and allows obtaining good patellar stability without functional limitations or growth disturbance.

References

1. Letts R, Davidson D, Beaulé P (1999) Semitendinosus tenodesis for repair of recurrent dislocation of the patella in children. *J Pediatr Orthop* 19(6):742–747
2. Baker RH, Carrol N, Dewar FG, Hall JE (1972) The semitendinosus tenodesis for recurrent dislocations of the patella. *J Bone Joint Surg Br* 54(1):103–109
3. Galeazzi R (1922) Nuove applicazioni del trapianto muscolare e tendineo (XII Congress Società Italiana di Ortopedia). *Archivio di Ortopedia*, p 38

ACL RECONSTRUCTION IN SKELETALLY IMMATURE PATIENTS

V. Guzzanti¹, M. Giordano², F. Falciglia²

¹University of Cassino (Cassino-IT); ²Institute of Scientific Research, “Bambino Gesù” Children’s Hospital (Rome-IT)

Objective Orthopaedic surgeons commonly avoid reconstruction by the graft fixation at both insertions sites in truly skeletally immature patients with anterior cruciate ligament (ACL) insufficiency [1, 2]. They fear the early closure of the growth plate with progressive deformity and/or leg length discrepancy and the unknown adaptability of fixed new ligament to growth. The authors report the methodology utilized for the study and the application of intra-articular ACL reconstruction techniques with graft fixation both in the femoral and in the tibial anatomical insertion sites, adapted and modified in patient with high, intermediate and low risk of growth disturbance [3, 4].

Material and Methods Preoperatively all patients are evaluated and subdivided into three groups according to puberal maturity level, bone age and lower limbs growth prediction. The first group includes preadolescents that are at high risk of growth disturbance; the second group includes adolescents at intermediate risk; and the third group includes adolescents at low risk. In the group 1 we recommend the reconstruction of ACL with an “all-epiphysis” technique. In the group 2 a physis (distal femoral physis) was crossed by a tunnel that should not exceed the 7% in the

frontal plan and 1% in the transversal plane of growth plate. In practice this results from a 6-mm tunnel. Both in the group 1 and in the group 2 an oblique 6-mm tunnel is drilled through the growing tibial epiphysis over the growth plate. In the group 3 the patients approach skeletal maturity so we can drill a tunnel both in femoral and in tibial physis. The semitendinosus and the gracilis tendons were used for the intrarticular ACL reconstruction.

Results In no patient did epiphyseal-physeal-complex damage result in significant lower limb growth disturbance at skeletal maturity. The grafted tendons fixed at both insertion sites showed adaptability to growth. Stability data at follow-up were satisfactory.

Conclusions It is still difficult to plan and delicate and of great responsibility to treat the ACL tears in skeletally immature patients. Nevertheless, it is equally difficult to delay ACL reconstruction until the end of skeletal maturity. Before planning surgery it is essential: (1) preoperative growth assessment; (2) preoperative measurement of the theoretical percentage of the physeal lesion in the frontal and transversal planes. Currently the diversified plan described above allows satisfactory results as concerns mechanical stability and functional integrity of the physis.

References

1. Stanitski CL (1995) Anterior cruciate ligament injury in the skeletally immature patient: diagnosis and treatment. *J Am Acad Orthop Surg* 3: 146–158
2. Kocher MS, Smith JT, Zoric BJ, Lee B, Micheli LJ (2007) Transphyseal anterior cruciate ligament reconstruction in skeletally immature pubescent adolescents. *J Bone Joint Surg Am* 89(12):2632–2639
3. Guzzanti V, Falciglia F, Stanitski CL (2003) Preoperative evaluation and anterior cruciate ligament reconstruction technique for skeletally immature patients in Tanner stages 2 and 3. *Am J Sports Med* 31(6):941–948
4. Guzzanti V, Falciglia F, Stanitski CL (2003) Physeal-sparing intraarticular anterior cruciate ligament reconstruction in preadolescents. *Am J Sports Med* 31(6):949–953

WRIST AND HAND

PERCUTANEOUS FIXATION OF CARPAL SCAPHOID FRACTURES

G. Caruso¹, A. Aquino¹, L. Preziuso¹, D. Lazzara¹, A. Vitali², A. Petrini¹

¹Orthopaedic Surgery and Traumatology, N.O.S.G.D.D. Hospital (Florence-IT); ²Health Firm Hand, I.O.T., Palagi Hospital (Florence-IT)

Objective Scaphoid injuries are the most common carpal fractures (range 70–78.8%) [1]. The purpose of this study is to analyse the advantages of the percutaneous treatment technique and to evaluate the long term follow-up in comparison with a preliminary study performed in 2004 [2]. Percutaneous fixation reduces exposure and soft tissue trauma, minimizes bleeding, scarring and infections. This technique can therefore be considered as a safe and effective alternative to conservative treatment.

Material and Methods The scaphoid fractures treated in our series (January 2000–November 2005) are those classified as type A2, B1 and B2 according to the Herbert classification. We reviewed 58 patients (47 males, 11 females) with scaphoid fractures, treated percutaneously by insertion of a 3-mm screw and a 5.5-mm washer. 54 patients had an acute fracture, 4 patients had suffered the fracture probably several months prior to treatment (range 1–2). Mean age

at time of surgery was 32.8 years (range, 14–68 years). The fractures were classified according to Herbert as follows: 14 were type A2, 15 type B1, 29 type B2. Fifty-two of the 58 patients returned for follow-up. Mean length of follow-up was 51 months (range, 13–83 months). Duration of surgery was 38 min on average (range, 18–70 min). All the patients were immobilized in short cast (including thumb) for two-tree weeks.

Results Results were evaluated according to a Mayo Wrist Score. Results were classified as excellent in 44 patients, good in 8. We observed radiological union less than 7 weeks in 50 cases, less than 10 weeks in 2 cases. We did not observe any cases of non-union. The average time until the patients returned to work was 7 weeks (range, 4–10 weeks). We did not observe long term complications, such as scapho-trapezium osteoarthritis.

Discussion and Conclusions With the recent advances in techniques and implants, percutaneous fixation of non displaced or minimally displaced carpal scaphoid fractures can achieve a nearly 100% union rate with only minimal complications. Using new devices, appropriately performed, acute percutaneous internal fixation is now a standard, effective and safe treatment option for a selected group of patients with acute scaphoid fracture [3].

References

1. Bond CD, Shin AY, McBride MT, Dao KD (2001) Percutaneous screw fixation or cast immobilization for nondisplaced scaphoid fractures. *J Bone Joint Surgery* 83-A:483–488
2. Caruso G, Martini L, Prezioso L, Vitali A, Petrini A (2005) Percutaneous AO screw fixation of carpal scaphoid fractures. *J Bone Joint Surgery* 87-B:175–176
3. Gutow AP (2007) Percutaneous fixation of scaphoid fractures. *J Am Acad Orthop Surg* 15(8):474–485

END-TO-SIDE NERVE SUTURE FOR THE TREATMENT OF COLLATERAL DIGITAL NERVE LESION: CLINICAL EXPERIENCE AND META-ANALYSIS OF THE LITERATURE

S. Artiaco¹, P. Tos², L.G. Conforti², P. Cartesegna¹, B. Battiston²

¹UOD Reconstructive Microsurgery, UOA Orthopaedics and Traumatology, ²Department of Orthopaedics and Traumatology, A.O. CTO-CRF-M. Adelaide (Turin-IT)

Introduction End-to-side nerve suture was first described by Leteivant in 1876. This neurorrhaphy is defined as the suture of an injured nerve stump to the epineurium of an intact donor nerve. Donor nerve axons are not divided except for the damage caused by suturing and by opening, if performed, the epineurial window. The experience in treatment of digital collateral nerve lesions with this technique is limited. For this reason we reported our clinical experience and systematically reviewed the literature.

Material and Methods In our Department of Orthopaedics and Traumatology from 2002 to 2006 we performed 7 end-to-side nerve sutures for digital collateral nerve lesion. After identification and preparation of the donor nerve the distal stump of injured nerve was sutured to an epineurial window of the donor nerve. The results were evaluated using the two-point discrimination test according to the Hightet scale of British Medical Research Council modified by Mackinnon-Dellon. From the analysis of literature we obtained homogeneous data regarding 17 patients operated with this technique. Then, the overall case series of meta-analysis included 24 patients.

Results In our experience we observed in all patients a sensitive recovery stated as S3+. The mean distance in two-point discrimination test was 12.5 mm (range, 8–15 mm). Considering the data reported in the literature, a sensitive recovery was observed in 23 of 24 patients. The functional result was S0 in 1 case, S3+ in 21 cases

and S4 in 2 cases. Except the only unfavourable case, the mean distance in two-point discrimination test was 9.7 mm (range, 3–15).

Conclusions The treatment of collateral digital nerve lesions with end-to-side suture showed positive results. The sensitive recovery observed after termino-lateral repair is similar to that reported in digital nerve repair with use of biologic and synthetic tubulization and autologous nerve graft.

Suggested readings

1. Mennen U (2003) End-to-side nerve suture in clinical practice. *Hand Surg* 8:33–42
2. Papalia I, Geuna S, Stagno D'Alcontres F, Tos P (2007) Origin and history of end-to-side neurorrhaphy. *Microsurgery* 27:56–61
3. Pelissier P, Rihai R, Casoli V, Martin D, Baudet J (2001) Les anastomoses nerveuses terminolaterales. Rapport clinique a propos de dix cases. *Ann Chir Plast Esthet* 46:129–133
4. Voche P, Quattara D (2005) End-to-side neurorrhaphy for defects of palmar sensory digital nerves. *Br J Plast Surg* 58:239–244

CANTILEVER EFFECT ON FIRST HAND COLUMN. CONSIDERATIONS RELATED TO PROSTHETIC TRAPEZIO-METACARPAL SURGERY

S. Cigni

Hand Surgery Simple Unit, SS Annunziata Hospital, ASL Pavia (Varzi-Pavia-IT)

Aim of this study was to evacuate influences on thumb biomechanics of tendon plasty in trapeziometacarpal surgery. Tendinous thumb structures acts on first column with a biomechanical cantilever effect as a physical mechanical suspended beam. Specific physical equations and formulas allow to determinate beam deflection relating to functional parameters; main parameters are applied forces (related to spatial arm positioning), length, diameter and thickness of beam and deformability (deflection equation as proposed by Stoney and related to Young's modulus and Poisson ratio). Trapezio-metacarpal articulation is centered in a balanced system including tendinous, muscular and ligamentous structures modified by forces provided with a different vectoriality and intensity (including gravity force). Balancing and coordination allow an effective functionality. Prosthetic surgery often modifies tendinous, ligamentous and bony structures, also modifying biomechanical effects on thumb spatial functionality. A different practical importance is assigned in scientific literature to the effects due to different surgical approaches but both in surgical and rehabilitating planning an accurate consideration of altered anatomical parameters (single and associated) is mandatory. Optimal functional balancing is a primary goal. Nature gave perfect tools to obtain perfect coordination related to function. Pathology always does modify articular interactions. Operative technique and planning have to be related to these considerations even if single patients functional demands and different pathoanatomies have also to be considered.

Suggested readings

1. Rongieres M (2004) Anatomy and physiology of the human trapeziometacarpal joint. *Chir Main* 23(6):263–269
2. Bettinger PC, Linscheid RL, Berger RA, Cooney WP 3rd, An KN (1999) An anatomic study of the stabilizing ligaments of the trapezium and trapeziometacarpal joint. *J Hand Surg Am* 24(4):786–798
3. Bettinger PC, Berger RA (2001) Functional ligamentous anatomy of trapezium and trapeziometacarpal joint (gross and arthroscopic). *Hand Clin* 17(2):151–168

CLINICAL AND BIOMECHANICAL FINDINGS IN THE USE OF A NEW METALLIC SUTURE FOR THE TREATMENT OF FLEXOR TENDON INJURIES OF THE HAND

A. Merolli¹, A. Gloria², L. Rocchi¹, L. Ambrosio², F. Catalano¹

¹Orthopaedics and Hand Surgery, The Catholic University (Rome-IT); ²Institute of Composite and Biomedical Materials, National Research Council (Naples-IT)

Objective To report on experience in treating 22 patients presenting primary flexor tendon injuries within the digital sheath in zone 2, with an intra-tendinous metallic anchoring device (Teno Fix™, Ortheon Medical, USA) and furthermore describe the mechanical measurement performed on the peculiar locking mechanism of the device.

Material and Methods The device has been used in 22 patients who were followed-up for a mean of 16 months. Clinical end points assessed included Total Active Motion and pulp-to-distal-palmar-crease distance. Mechanical tests were performed in a tensile mode in order to evaluate the load at which failure occurred. Since, in the clinical practice, the strength of the stop bead results crucial, two tests were carried out for evaluating the load needed to pull out the lower and upper stop beads from the wire. The tests were performed at 1-mm/min using an INSTRON 5566 with a load cell of 100 N.

Results Clinical results were, according to Strickland and Glogovac criteria: 12 excellent; 6 good; 3 fair. We noted that it is peculiar to this device that the intratendineous complex allow the collagen fibres, entangled between the coil and the core, to maintain their physiological elongation without the excessive twisting and/or constriction which may occur with the ordinary stranded suture. Mechanical results showed typical load-displacement curves generally linear until maximum load values of 56.7 N and 58.9 N were reached. In both tests the wire resulted damaged, but the stop bead did not pull out from it.

Conclusions This device is practical clinically and can produce strong tendon repairs that withstand early active finger motion but the best indication is to treat only selected cases of sharp flexor tendon lesions in zone 2. By this technique it is possible to achieve a fast functional recovery and return to work. The mechanical performance of the system was adequate to cope with usual requirements of routine clinical practice. Even in the most operator-dependent surgical step, namely the locking of the stop-bead, no failure in the coupling between the bead and the wire occurred.

THE SURGICAL TREATMENT OF METACARPAL FRACTURES WITH MINIEXTERNAL FIXING SYSTEM

N. Galvano, A. Parlato, O. Ferrara, M. D'Arienzo

Clinica Ortopedica e Traumatologica, Università degli Studi di Palermo (Palermo-IT)

Metacarpal fractures are 25% of all the fractures of the hand, and they are treated bloodlessly in the 80% of cases; in the cases in which the surgical treatment is necessary we perform a percutaneous synthesis that it allows to grant the early mobilization. The miniexternal fixing system that we use is X-ray-transparent and it is endowed with holes of the diameter of 2 mm through which we jam the threads of Kirschner to stabilize the fracture. We surgically treated 25 patients (16 men and 9 women) with decomposed metacarpal fractures. The removal of the mini-fixer was performed about after 50 days, and however when the controls

showed a complete consolidation. We appraised our patients according to clinical (T.A.M.) and radiological criterions. Our results were excellent in 80% of cases and the patients had a rapid and complete recovery of the functionality, also when the radiological result was not very good. We believe that the absence of pain and the express and complete functional recovery must prevail on the radiological aspect of the result because the anatomical reconstruction of the bone isn't always synonymous of recovery: the miniexternal fixing system in comparison to other types of synthesis has a smaller frequency of complications and it represents a simple and economic surgical choice.

NEW INTERNAL RE-ABSORBABLE DEVICE FOR TENDON SUTURE IN REPAIR OF RUPTURED FLEXOR TENDONS

G. Vasario¹, R. Mandrile², S. Artiacono¹, G. Ciardelli², B. Battiston¹

¹Interdisciplinary Microsurgery Group, Azienda Ospedaliera C.T.O.-CRF-Maria Adelaide (Turin-IT); ²Politecnico di Torino, Biomechanical Research Group (Turin-IT)

Objective The early recovery of the kinetic functions of a finger in full range of motion after flexor tendon injury and repair is a challenging issue in hand surgery. After flexor tendon repair there are often problems in tendon gliding at the repair site, which is greater for techniques using increased suture strands or suture material, while the initial resistance of the repair remains a critical point. The authors present a biomechanical model of a new internal re-absorbable device for tendon suture.

Material and Methods We considered the possibility of utilizing an internal device for tendon suture in different re-absorbable materials and designs in the repair of ruptured flexor tendons. The authors present a biomechanical study of tendon behaviour after primary suturing with internal re-absorbable device (made of different mix of poly-lactic-acid and poly-ε-caprolactone) for tendon suture using five biomechanical parameters: the load at rupture (R), Young's modulus of elasticity (E), gapping (RG), cycling loading (RCL), pulley loading (Rpl). Different tendon-device sutures are also compared and tested, for a total of 320 suine flexor tendons sutured.

Results Different types of sutures models are compared using different re-absorbable biomaterials and shapes to accomplish internal reabsorbable device technique best-match (Fig. 1). The results are compared with the most common tendon sutures used in clinical practice. Our device showed an average peak load of 52.6 N with the best performance achieved by the PLA 20%/PCL 80% mix (73.26 N, SD 3.95, $p < 0.05$). The same mixture showed the best performance also in cycling load tests (Medium Gap 1.7 mm, SD 0.11), while in pulley loading the PLA 100% showed slightly better results (61.56 N, SD 3.38) (Fig. 2)

Conclusions The effectiveness of the repair of ruptured tendons utilizing internal re-absorbable devices showed mean load at rupture values statistically superior to the most common used techniques in literature and comparable to the other bulky and

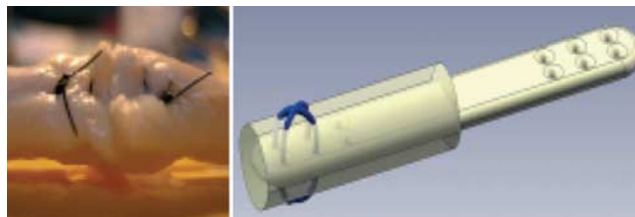


Fig. 1 Suture models

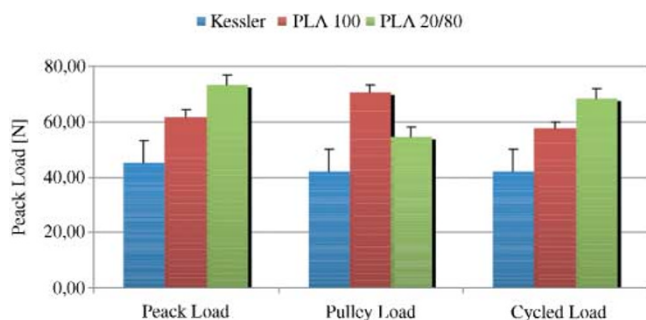


Fig. 2 Results of our device compared with the most common tendon sutures used in clinical practice

non-re-absorbable market-available devices. Further investigation with a larger testing sample, in vivo and in human cadaveric model, is needed in order to assess usability. This could open new frontiers in hand surgery and address new solutions for tendon repair.

Suggested readings

1. Su BW, Protopsaltis TS, Koff MF, Chang KP, Strauch RJ, Crow SA, Rosenwasser MP (2005) The biomechanical analysis of a tendon fixation device for flexor tendon repair. *J Hand Surg [Am]* 30(2):237–245
2. Trail IA, Powell ES, Noble J (1992) The mechanical strength of various suture techniques. *J Hand Surg [Br]* 17(1): 89–91
3. Zatiti SC, Mazzer N, Barbieri CH (1998) Mechanical strengths of tendon sutures. An in vitro comparative study of six techniques. *J Hand Surg [Br]* 23(2):228–233

DISTAL RADIUS FRACTURES TREATED WITH ELASTIC PERCUTANEOUS PINNING OR EXTERNAL FIXATION: OUR EXPERIENCE IN 48 PATIENTS

R. Iundusi, E. Gasbarra, M. Celi, G. Cannata, D. Lecce, U. Tarantino

Orthopaedics and Traumatology Department, PTV Hospital, University of Rome “Tor Vergata” (Rome-IT)

Objective Distal radius fractures are among the most frequent traumatic skeletal injuries with an incidence higher to 15% of all fractures. Many surgical techniques are available: percutaneous Kirschner wires, elastic percutaneous pinning, external fixation, open reduction and internal fixation. The purpose of this study was to evaluate the reduction of pain, complications and results of distal radius fractures treated with elastic percutaneous pinning or external fixation.

Material and Methods From July 2007 to February 2008, 48 patients, 30 women and 18 men, with average age of 54 years (range, 22–84 years), underwent surgical treatment for distal radius fractures. 26 patients were treated with elastic percutaneous system (MiroS, 2B1 srl) and 22 patients with external fixator (WristoreTM; Zimmer, Inc.). After surgical treatments no wrist orthosis was used in both cohorts of patients. Patients were screened with plain radiographs at one and at three months after the surgical procedure. Pain (Visual Analog Score), clinical outcomes and patients' satisfaction were evaluated at three months.

Results Final radiographic controls (at three months) showed that all fractures achieved bone healing. There was no deep infection while 5 patients (10.4%) had superficial infections (3 patients treated with Wristore and 2 with MiroS) which were resolved with topical antibiotic medication. Time to remove implants was 35 days (range, 30–38 days) for MiroS and 45 days (range 39–48 days) for

Wristore. Both systems were well tolerated by the patients, although MiroS seemed more favored.

Discussion In the past, distal radius fractures were considered as a homogeneous group of lesions with excellent or good prognosis regardless of the type of treatment. Today there is the right belief that the final outcome is influenced by the fracture severity, age, bone quality and the functional demands of the patient, and by the treatment performed.

Conclusions Percutaneous pinning system MiroS has proved reliable and safe especially for treatment of extra- or partially-articular wrist fractures and in elderly patients. External fixator Wristore conferred excellent results in intra-articular and comminute wrist fractures and in young patients.

STATE OF THE ART ON THE KNOWLEDGE OF CARPAL KINETICS: THE BIARTICULAR CONCENTRIC CARPAL CONCEPT AND COXA MANUS SURGERY

G.M. Grippi

MO of Hand Surgery, UOA of Orthopaedics and Traumatology, San Lazzaro Hospital of Alba, ASL 28 of Piemonte (Alba-Cuneo-IT)

Objective Carpal kinetics is an essential knowledge in the clinical-surgical judgment. In literature, that has been an enigma replaced by uncertain thesis. The historical carpal models: columnar (Navarro, 1919), chain movement (Gilford, 1943), Kapandj (1974), geometry varying (Taleisnik, 1976), the ring (Lichtman 1981) have not disclosed the secret of carpal structure. The consequences have been the clinical and surgical approximation.

Material and Methods Recently, the gap has been reduced by the modern Biarticular Concentric Carpal concept (BCC) [1]: (1) carpus is devised as a femur biarticular prosthesis in which the little-head is reproduced by the capitate's head that, on scaphoid and lunate, constitutes the enartrosic articulation of the Coxa Manus (CM); the carpal condyle as a meniscus, contains it and warrants its mechanical stability; (2) during the movement, the two carpal rows maintain the radiocarpic-axle/hand-axle convergence in a point that, coinciding with the capitate's head, identifies the rotation carpal centre (CR); (3) the CM disruption defines carpal instability (CI); in practice, the check of a static or dynamic displacement of capitate's head is patognomonic of CI. In the carpal lesions the surgical target is to obtain the CR restoration-reposition; and Coxa Manus Surgery (CMS) is the correspondent methodology: when restitutio ad integrum is possible, the osteosynthetic and/or the lig-

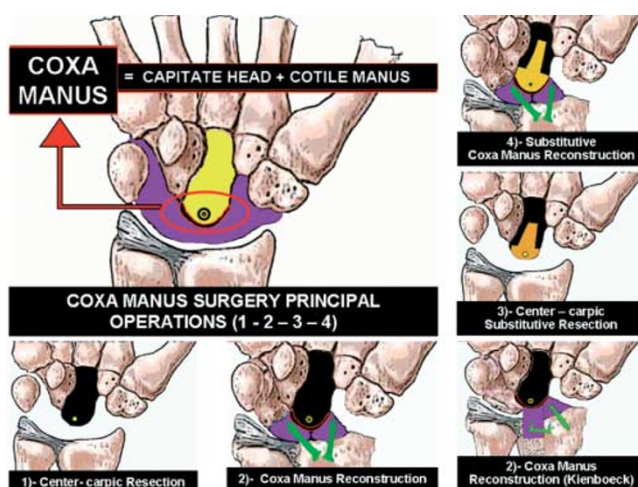


Fig. 1

ament reparation is enough to reset the CR; conversely, if this is impracticable, a valid option is “to simplify the carpal function” by concentration of movement on capitate head (or, if this is damaged, using a substitutive prosthesis). In this way, according to the damage, the capitate head (or its prosthesis) can be articulated on the radius-lunate-emiscaphoid arthrodesis (Coxa Manus Reconstruction) [2] or can be articulated on the radio by Substitutive center-carpic resection-arthroplastic [3].

Results, Discussion and Conclusions The application of CMS to the SLAC/SNAC/SCAC wrist, to the failures and malunions of distal radius fractures, to the failures of the scaphoid non-union surgical treatment, to the damages following post traumatic treatment, to the collapsed Kienboeck, etc., in 52 cases from 1997 to 2007 (follow-up of 5.3 years) has put again in discussion other surgical solutions and got reliable and satisfactory clinical results.

References

1. Grippi GM (1997) Cinematica del condilo carpale con introduzione al Modello Carpale Biarticolare Concentrico (MBC) e sua applicazione al problema dell'instabilità carpale. *Riv Chir Riab Mano Arto Sup* 34(3):389–401
2. Grippi GM (2003) La ricostruzione della “Coxa Manus” Indicazioni e tecnica chirurgica. *Riv Chir Mano* 40(3)
3. Grippi GM (2006) La protesizzazione del capitato – indicazioni e tecnica chirurgica. *Riv Chir Mano* 43(1)

FOOT AND ANKLE

TREATMENT OF INTRACTABLE METATARSALGIA WITH A CIRCULAR NECK METATARSAL OSTEOTOMY FIXED BY BIOABSORBABLE PINS: RESULTS OF A NEW SURGICAL TECHNIQUE

A. Folliero¹, L. Bondi²

¹Clinica Madonna della Fiducia (Rome-IT); ²Clinica Valle Giulia (Rome-IT)

Introduction Pathology of the metatarsal region represents one of the most common problems in foot. The treatment of inveterate lesser metatarsalgia remains controversial. Few options exist and different are problems and results reported.

Aims Aware of good results recently obtained with SR-PLLA devices, in order to reduce complications and patient rest after lesser metatarsal osteotomies usually performed for metatarsalgia treatment, we adopted a circular neck metatarsal osteotomy with an intramedullary absorbable poly-L-lactic acid pins fixation. This paper reports on results we have obtained.

Material and Methods Nine patients with inveterate metatarsalgia underwent circular metatarsal neck osteotomy with absorbable pins of the following sizes: (1) 3.2 mm × 50 mm; (2) 3.2 mm × 60 mm; (3) 3.2 mm × 70 mm. Ankle block anaesthesia was administered for all cases and all procedures were performed under tourniquet control applied at the ankle. Clinical examination and X-rays controls were done three, six, twelve weeks and one year after surgery. In addition all patients were followed-up with magnetic resonance imaging (MRI). The American Orthopaedic Foot and Ankle Society (AOFAS) lesser metatarsophalangeal-interphalangeal 100-point scale concurrently with the MODEMS TM, (Musculoskeletal Outcomes Data Evaluation and Management System) Foot and Ankle Booklet were administered to the patients. The results were analysed through widely statistical analysis.

Results All operated patients healed in about 2 months without prolonged rest or cast immobilization. Serial radiographs showed solid union at osteotomy site. SR-PLLA pins can provide a good

stable metatarsal fixation during bone healing. The surgical technique performed, the circular neck metatarsal osteotomy, seems to be a good treatment choice despite the other techniques.

Suggested readings

1. Folliero A, Bondi L, Avitto A, Bellelli A (2004) Absorbable self-reinforced poly-L-lactic (SR-PLLA) pins fixation in metatarsal fractures: 3-Year follow-up. *J Bone Joint Surg (BR)* 86-B[Suppl III]
2. Folliero A, Bondi AL (2001) “Gli impianti bio-riassorbibili come mezzi di sintesi nel trattamento delle fratture metatarsali”. *Biomateriali* 3:23–24
3. Folliero A (2004) La volta plantare normale e patologia. Aracne Editrice

HEEL COVERAGE USING A DISTALLY BASED SURAL ARTERY FASCIOTOMY CROSS-LEG FLAP: REPORT OF A SMALL CASE SERIES

A. Basile, M. Stopponi, A. Loreti, A.U. Minniti De Simeonibus

Ospedale San Giovanni Addolorata (Rome-IT)

One of the goals in the management of severe open injuries of the foot is to obtain adequate soft tissue coverage.

In extreme conditions, in presence of foot soft tissue defects, with inability to perform either local or free-tissue transfer, the cross-leg flap re-emerges as an option for surgical reconstruction.

We present the results of 7 trauma patients with multiple lower limb open fractures associated to ipsilateral degloving injuries and/or secondary pressure ulcers of the hindfoot with exposed calcaneus bone, in which the distally based sural artery island fasciotomy flap elevated from the contra-lateral leg and crossed to the injured side was used to repair the soft tissue defects of the heel. All the flaps survived totally and soft tissues healed uneventfully providing satisfactory and stable coverage of the calcaneal tuberosity.

To the best of our knowledge this is the first report in which such technique has been used to repair hindfoot soft tissue defects associated to complex bone and vascular injuries of the lower limb in polytrauma patients.

THALAMIC FRACTURES OF THE CALCANEUS: CLINICAL AND RADIOLOGICAL STUDY AND FOLLOW-UP

G. Manfredini¹, E. Tripoli¹, C. Barbieri¹, S. Ravaioli², M.T. Donini¹, A. Canali¹, S. Colopi²

¹Division of Orthopaedics and Traumatology, ²Service of Radiology and Radiodiagnosis, Azienda Ospedaliero-Universitaria Policlinico of Modena (Modena-IT)

Thalamic fractures of the calcaneus are still the subject of confrontation and discussion on which is the ideal treatment. Recently, several authors have emphasized that the mini-invasive techniques produce results entirely consistent, if not better, in fractures type 2 and 3 of the classification of Sanders. This statement was necessary because the post-operative complications of “open” surgery are high and sometimes difficult to resolve. The purpose of this study was to review at a distance of several months (follow-up minimum 18 months) a group of patients operated for Thalamic fractures of the calcaneus of type 2 and 3 (classification of Sanders) with different techniques and to reassess the clinical and instrumental results trying to understand which factors are correlated with a good result. We examined 30 cases of thalamic fractures, computing through reconstruction CT, the

main measures and calcaneal axes and correlated them with the parameters of clinical evaluation form (MFS and AOFAS). The clinical and radiological evidence showed that the good reconstruction of calcaneal morphology (length, width and height) is the main factor responsible for a good ultimate result. In some cases, however, there are variables that affect the final result despite of the good or discrete reduction; these factors are the hidden injuries of cartilage that depend on the trauma and general risk factors of the patient.

OPERATIVE TREATMENT OF CALCANEAL FRACTURES IN ELDERLY PATIENTS

A. Basile

Ospedale San Giovanni Addolorata (Rome-IT)

Historically, displaced intra-articular calcaneal fractures (DIACFs) were treated non-operatively, as predictable operative reduction and fixation was not possible.

Operative treatment has become more accepted in the last ten to fifteen years as a result of improvements in preoperative evaluations, use of intraoperative imaging to verify the quality of reduction, and advancements in surgical techniques and soft tissue

management. The goal of the operative intervention is the anatomic reduction of the joint surfaces and the reestablishment of the hindfoot and gastrocnemius soleus biomechanics. Reconstruction of the joint lines and resumption of the original bone alignment should enable the patient to have the best chance of functionality restoration regardless the initial cartilage injury produced during trauma.

Literature supports the recommendation to avoid surgery in all patients over the age of fifty because of the expectation of poor outcomes. Recently an investigation performed by Herscovici et al. challenged this statement sustaining that open reduction and internal fixation appears to be an acceptable method of treatment for DIACFs in a careful selected population of elderly patients.

The purpose of this paper was to compare the outcomes of DIACFs in a selected population of patients between the age of sixty-five and seventy-five treated operatively and non-operatively. To the best of our knowledge this is the first report in which such a comparison has been investigated. Our hypothesis was that ORIF of DIACFs in healthy and active elderly patients results in better outcome compared to the non-operative treatment (NOT).

The operative treatment group scored higher on both the AOFAS and the VAS scales compared to the non-operative group with the difference being statistically significant, suggesting that results can be improved by operative treatment even in a selected population of elderly patients.

ORAL PRESENTATIONS

KNEE AND SPORTS TRAUMATOLOGY

ACL RECONSTRUCTION WITH THE ALL-INSIDE TECHNIQUE

G. Cerulli¹, F. Vercillo¹, C. Senni², A. Amanti¹, P. Antinolfi¹

¹Orthopaedics and Traumatology, University of Perugia (Perugia-IT); ²University of Nice (Nice-FR)

The use of the hamstring tendon graft for single bundle anterior cruciate ligament (ACL) reconstruction has some disadvantages including harvesting both the semitendinosus and gracilis tendons, which directly influences muscle strength and knee function and stability. Recently, an all-inside technique for single bundle ACL reconstruction has been developed to avoid the need to harvest both hamstrings tendons. In this technique, the femoral and tibial half-tunnels are drilled through the bone manually with a special device from the inside-out. The decreased length of the bone tunnels means only one hamstring tendon (semitendinosus or gracilis) is necessary. Additional advantages include no burning of the tunnel, common with electrically powered drills, the ability to adjust the tunnel length, good fixation in the half-tunnel, easier graft attachment, limited aesthetical damage, lower risk of infection, and less bleeding. At a medium follow-up (29 months), excellent clinical results have been experienced with good patient satisfaction, a rapid return to previous activity, satisfactory stability, and good muscle function (Cerulli G, ESSKA Congress, Innsbruck, 24–25 May 2006).

BIOMECHANICS OF ACL PROXIMAL FIXATION WITH STGR AND BTB

C. Fabbriani, G. Milano, V. Izzo, L. Deriu

Istituto di Clinica Ortopedica, Università Cattolica del Sacro Cuore (Rome-IT)

Purpose To evaluate the structural properties of femur-patellar tendon graft and doubled hamstring tendon graft complex in anterior cruciate ligament (ACL) reconstruction using different femoral fixation devices.

Methods Forty porcine knees underwent ACL reconstruction using patellar tendon (PT) graft. Specimens were divided into four groups according to femoral fixation: interference absorbable screw (Group A), metallic setscrew (Group B), absorbable pins (Group C), and a combination of metallic setscrew and pin (Group D). Ten knees were used as controls. Other 90 porcine knees underwent ACL reconstruction using doubled lateral extensor of toes (DLET). Nine different femoral fixation devices were tested: compression (Bioscrew and RCI screw); expansion (Rigidfix); cortical suspension (Ligament Anchor, EndoButton-CL, and Swing Bridge); cancellous suspension (Linx-HT); and cortical-cancellous suspension (Transfix and Bio-Transfix). Cyclic loading test, load-to-failure test were performed. Elongation after 1,000 loading cycles, failure load, stiffness, and mode of failure were recorded. Kruskal-Wallis test and Tukey test were used to compare the differences between groups.

Results The lowest mean elongation after 1,000 cycles was observed for Group B (1.7 ± 1.4 mm) and D (1.2 ± 0.3 mm). Failure load of Group D ($1,021.8 \pm 199.4$ N) was comparable with normal ACL ($1,091.2 \pm 193.3$ N) and PT graft ($1,140.6 \pm 285.7$ N). All other groups were lower than the controls. For mean stiffness, all the groups, except Group D (172.8 ± 40.4 N/mm), were significantly lower than control group (216 ± 78.4 N/mm). Mode of failure was graft pullout for Groups A and B, distal pin breakage for Group C, and midsubstance graft rupture for Group D. Bioscrew and RCI screws showed the highest graft elongation. All the other GFC showed no significant differences between them for delta elongation (elongation (1000 cycles) – elongation (20 cycles)). Bio-Transfix, Transfix, and Swing Bridge showed the greatest failure load and stiffness; Ligament Anchor, RCI screw, Bioscrew, and Linx-HT showed the lowest mean values without differences between them.

Conclusions Only combined compression and suspension fixation did not show significantly different structural properties respect to normal ACL and PT graft. Furthermore, it showed no risk of pullout or hardware breakdown respect to other fixation devices. Cortical-cancellous suspension fixation shows the best and most predictable results in terms of elongation, fixation strength, and stiffness. For both compression and suspension, the weakest fixation was attained with cancellous fixation devices. Cortical suspension devices showed a greatly variable mechanical behaviour, according to their design.

GRAFT HEALING AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

A. Schiavone Panni, S. Cerciello, M. Tartarone, M. Vasso, D. Santaiti, C. Mazzotta

Science for Health Department, Molise University (Campobasso-IT)

Hamstring and bone patellar tendon represent the most common grafts in case of anterior cruciate ligament (ACL) reconstruction. Beside graft biomechanical properties and tunnel positioning, tendon remodelling has been the subject of several studies. Tendons and ligaments have different histological properties. ACL is rich in cells which are ovoid in shape and covered by microvilli. Both tendons and ligaments have a common characteristic which is called “crimp” which is the peculiar propeller shape orientation of the matrix.

After ACL reconstruction, patellar tendon graft goes through some histological changes. Cells loss occurs immediately after surgery and 15 days postoperatively a necrosis of the whole graft can be seen. This phase is probably the consequence of blood supply interruption and denervation. After this necrosis a colonization of new cells occurs and a proliferation phase begins. These cells have a fibroblast like shape and they have intense metabolic activity. The peak of metabolic activity is reached 3 weeks after surgery and come back to the level of a normal ACL after 30 weeks. The origin of these cells is still unclear, some authors suggest they are mesenchimal like cells coming from bone marrow through new vessels or synovial fluid. Others suggest they are fibroblast like cells coming from the periosteum and that differentiate into mature fibroblast in presence of proper conditions. Finally they could be intrinsic cells.

Graft remodelling is a 4-stage process: (1) Stage of colonization (first 2 months) – a moderate increase in cells number and metabolic activity occurs if compared to a normal patellar tendon; collagen matrix is well organized even if necrotic areas can be found; (2) stage of fast remodelling (2 months to 1 year) – a huge increase in

fibroblasts number occurs as well as metabolic activity and new vessel proliferation; several necrotic areas can be found and the amount of mature collagen decreases; (3) stage of ripening (1 to 3 years) – a decrease in cells and vessels number, and metabolic activity occurs; an increase in the amount of mature collagen is present; (4) end stage (after 3 years) – graft has histological properties similar to the ones of a normal ACL, no further changes occur.

Besides this process of graft remodelling some changes occur at the bone-tendon junction. This junction is a 1-cm thick anatomic structure formed by 4 zones: fibrous tissue, fibrocartilage, mineralized fibrocartilage and bone. This architecture is complex and allows for a correct tensile forces distribution from tendon (which has an elastic behaviour) to bone (which is stiff). The restoration of this architecture is mandatory after ACL reconstruction. In a previous study we analyzed the remodelling of this junction. Two weeks after surgery the ligament was oedematous and partially degenerated; three weeks later the new ligament and the tunnel wall are still separate, even if there is no inflammation tissue. At 8 weeks a thin fibrocartilage layer is present between ligament and bone and 4 weeks later it develops into calcified fibrocartilage. At 16 weeks the junction has a physiological architecture even if the four zones are thinner. At 38 weeks the new junction is completely remodelled and has the same characteristics of a normal junction. Moreover we analyzed the restoration of this junction in case of “out-in” and “in-out” techniques.

In the “in-out” group the bone tendon junction is placed at the intra-articular side of femoral tunnel. This intra-articular part undergoes fast loss of cells, leading to a necrosis of the graft 2 weeks after surgery. Then a phase of revascularization and repopulation occurs having its peak 3 months after surgery. Finally occurs remodelling and maturation of the graft, cells differentiate into fibroblasts and after 9 months graft has the same histological properties of a normal ACL. Since the tendon is outside the bone tunnel there is no formation of a new junction along the walls of the tunnel and this permits the distribution of the tensile forces only on the longitudinal direction.

In the “out-in group” the bone tendon junction is situated into the femoral tunnel. On the femoral side, the bone-graft interface shows an initial fibro-vascular tissue rich in cells. One month after surgery we found an organization of this tissue in fibres parallel to the axis of the graft. At 3 months these fibres coming from the graft had an oblique direction toward the bone. It is supposed that these fibres act as an anchorage system in a similar way as Sharpey’s perforating fibres. This new junction shows a fibrocartilage zone which is well organized around 6 months after surgery and causes a modification of the forces along the neoligament. The distribution of the junction surface involves not only the end of the neoligament but also the periphery of the fibrous part inside the tunnel. Thus a gradient of distribution of tensile forces acts from proximal to distal and from the center to the periphery of the graft (in an axial plane). Moreover the new junction along the tunnel walls has a wider surface than the old bone-tendon junction (because it is quite unloaded). The old junction is partially unloaded and undergoes histological modifications as a consequence of the distribution of the loads inside the tunnel. This junction shows an initial necrosis and degeneration of the fibrocartilaginous zone, then a remodelling process occurs leading to the formation of a new junction comparable to the one described at the interface between tunnel walls and graft, although this process is slower (9 months and 6 months respectively).

GROWTH FACTORS IN THE MANAGEMENT OF SPORT-INDUCED TENDINOPATHIES

P. Volpi¹, L. de Girolamo¹, G. Banfi³, H. Schoenhuber¹, G. Melegati²

¹Centro di Traumatologia Sportiva e Chirurgia Artroscopica, ²Centro di Riabilitazione Sportiva, ³Direzione Sanitaria, IRCCS Istituto Ortopedico Galeazzi (Milan-IT)

Objective It has been demonstrated that growth factors contained in autologous platelet-rich plasma (PRP), are able to enhance fibroblast migration and proliferation, up-regulate vascularization and increase collagen deposition in a variety of *in vitro* and *in vivo* models. In our study we evaluated the use of autologous platelet rich plasma (PRP) injection as a treatment for chronic tendinopathies in a group of 15 patients practising sport either at professional or amateur level, also analysing the possible systemic effects of PRP injections.

Material and Methods Fifteen patients (36.13 ± 15.05-year-old, range 17–68 years) with unilateral or bilateral tendinopathies at Achilles, quadriceps, anterior tibial and elbow tendons were treated with PRP injections. Patients were clinically assessed before treatment and at 7, 30, 60 and 90 days after injections. A VISA score was calculated pre-operatively and after 90 days from treatment. MRI were performed prior to the treatment and then repeated after 90 days. A series of serum cytokines and growth factors from the peripheral blood of 5 treated patients were measured. Blood was drawn before and 30 min, 3 h and 24 h after the treatment.

Results At 90 days post-op the VISA scores significantly improved from a mean of 35.64 ± 12.57 (range 21–64) to 74.07 ± 17.74 (range 40–92) ($p < 0.001$). In particular, satisfactory improvement was achieved in the treatment of patellar tendinopathies: the mean score for the 8 patients (12 injections) moved from 39 ± 15.98 (range 21–64) to 80.25 ± 12.30 (range 54–92). MRI after 90 days showed a marked reduction of the irregularities in 80% of the analyzed tendons. No changes in IL, TNF α and interferon γ . VEGF, EGF and CCL2 decreased progressively from 30 min to 3 h after the treatment and returned to near the baselines after 24 h.

Discussion These findings suggest that PRP-based local therapy in sport tendon pathologies improves the symptomatology in most of the cases and that this kind of procedure could be an alternative to surgery in patients who have failed non-operative treatments. The PRP-based local therapy in sport tendon pathologies could influence systems homeostasis and antidoping evaluations, but, in our opinion, it doesn’t represent a doping substance in itself. The limits of the present study are the small number of subjects and the lack of controls, due to the restriction of the Italian Ethical Committees. Further studies with a larger number of patients are requested to confirm the efficacy of growth factors in tendinopathies.

SHOULDER AND ELBOW

PERSONAL TECHNIQUE FOR SHOULDER INSTABILITY

G. Cerulli^{1,2}, S. Bruè², P. Antinolfi¹, A. Caraffa¹, F. Fantasia¹

¹Department of Orthopaedics and Traumatology, University of Perugia (Perugia-IT); ²International Orthopaedics and Traumatology Institute, Nicola’s Foundation ONLUS (Arezzo-IT)

Introduction The purpose of this study is to report the long term results of our treatment of first time traumatic shoulder dislocations with early arthroscopic Bankart repair with percutaneous K-wires in a group of young athletes.

Material and Methods Between February 1989 to December 1995 we performed acute arthroscopic Bankart repairs in 29 young subjects. The inclusion criteria were: athletes below 30 years, with first time traumatic dislocation, without any history of subluxation, important hyperlaxity or glenoid fracture. A Bankart lesion was

present in 25 cases (86.4%). The subjects with Bankart lesions were 22 males and 3 females with a mean age of 21.2 years (range 16–30). Arthroscopic Bankart repair was performed at a mean of 12 days after the dislocation (range 9–16 days).

Surgical procedure General anaesthesia was used. The patients were positioned in a beach-chair position. A traditional posterior portal was used for introduction of a 30° 4-mm arthroscope and an anterior-superior portal was then created. Treatment of the Bankart lesion was performed in 5 steps: lavage and an examination of the joint; abrasion of the anterior glenoid neck and rim to obtain bleeding; an accurate superior mobilization of the capsulolabral tissue and reduction of the labrum; fixation of the capsulolabral tissue with a Kirchner-wire. Two or three K-wires can be used for final stabilization. Postoperatively the shoulder was placed in a sling.

Results Of the 25 patients with Bankart lesion, 2 were lost to follow-up. The average follow-up was 7 years and 8 months with a range of 5.3–11.2 years in 23 cases. Methods of evaluation are outcome, clinical examination, and functional evaluation with Constant score and isokinetic measurement. In 2 cases (8.6%) the arthroscopic repair had failed. They are two males, 19 and 23-year-old. According to the Constant score, 14 patients (60.8%) had 100 points, 7 patients (30.4%) more than 85 points and in 1 case (4.3%) 73 points. Isokinetic measurements were compared with a control group of young subjects with a normal shoulder.

Discussion There are arguments for early repair [1, 2] and arguments for a more non-operative approach where one should wait for possible recurrence of the dislocation. Many different techniques for Bankart repairs have been suggested like suture anchors, biodegradable tacs like our technique with Kirschner wires [3]. Our technique of repair with K-wires gives good long term results with low frequency of recurrence and good shoulder function.

References

1. Arciero RA, Taylor DC, Snyder RJ et al (2002) A prospective, randomized evaluation of arthroscopic stabilization versus non-operative treatment in patients with acute, traumatic, first-time shoulder dislocations. *Am J Sports Med* 30(4):576–580
2. De Berardino TM, Arciero RA, Taylor DC, Uhorchak JM (2001) Prospective evaluation of Arthroscopic Stabilization of Acute, Initial Anterior Shoulder Dislocations in Young Athletes. *Am J Sports Med* 29(4):586–592
3. Cerulli G, Bonivento G, Buonpadre V (1993) Valutazione e trattamento artroscopico delle lussazioni gleno-omerali acute. *Artroscopia e ginocchio* 1(3):33–35

THE ROMAN BRIDGE: A NEW TECHNIQUE FOR ROTATOR CUFF REPAIR

F. Franceschi¹, U.G. Longo¹, L. Ruzzini¹, G. Rizzello¹, N. Maffulli², V. Denaro¹

¹Department of Orthopaedic and Trauma Surgery, Campus Biomedico University (Trigoria-Rome-IT); ²Department of Trauma and Orthopaedic Surgery, University Hospital of North Staffordshire, Keele University School of Medicine (Stoke on Trent-UK)

With advances in arthroscopic surgery, many techniques have been developed to increase the tendon-bone contact area, reconstituting a more anatomic configuration of the rotator cuff footprint and providing a better environment for tendon healing.

We present an arthroscopic rotator cuff repair technique which uses suture bridges to optimize rotator cuff tendon-footprint contact area and mean pressure.

Two medial row 5.5-mm Bio-Corkscrew suture anchors (Arthrex, Naples, FL), which are double-loaded with No. 2 FiberWire sutures

(Arthrex, Naples, FL), are placed in the medial aspect of the footprint. Two suture limbs from a single suture are both passed through a single point in the rotator cuff. This is performed for both anchors. The medial row sutures are tied using the double pulley technique. A suture limb is retrieved from each of the medial anchors through the lateral portal, and manually tied as a six-throw surgeon's knot over a metal rod. The two free suture limbs are pulled to transport the knot over the top of the tendon bridge. Then the two free suture limbs that were used to pull the knot down are tied. The ends of the sutures are cut. The same double pulley technique is repeated for the other two suture limbs from the two medial anchors, but the two free suture limbs are used to produce suture bridges over the tendon, by means of a Pushlock (Arthrex, Naples, FL), placed 1-cm distal to the lateral edge of the footprint.

This technique maximizes the advantages of two techniques. On the one hand, the double pulley technique provides an extremely secure fixation in the medial aspect of the footprint. On the other hand, the suture bridges allow improving pressurized contact area and mean footprint pressure. In this way, the bony footprint is not compromised by the distal-lateral fixation, and it is thus possible to share the load between fixation points. This maximizes the strength of the repair and provides a barrier preventing penetration of synovial fluid into the healing area of tendon and bone.

PLATELET DERIVED GROWTH FACTORS IN ROTATOR CUFF REPAIR. A PROSPECTIVE STUDY: TWO-YEAR FOLLOW-UP

P. Randelli, P. Arrigoni, P. Cabitza

Dipartimento di Scienze Medico-Chirurgiche, IRCCS Policlinico San Donato, Università degli Studi di Milano (Milan-IT)

Objective Healing of the rotator cuff after surgical repair continues to be one of the most challenging areas of shoulder surgery. Autologous Platelet Derived Growth Factors (PDGF) have been shown to positively affect the tissue healing, but their effect have not been studied in relation to tendon healing. The purpose of this study is to evaluate if the use of PDGF in rotator cuff surgery could lead to a better and faster healing of the repair.

Material and Methods We treated two groups (A, B) of 14 shoulders (mean ages, 66 and 63.4) with a full thickness rotator cuff tear. The groups had a full arthroscopic repair of the cuff. In the group A, at the end of the procedure, the PDGF were injected at the level of the lesion, between the tendon and the bone and over the tendon repair without irrigation. The group B, repaired in the same fashion, without PDGF, has been used as control. In the group A the patients had an accelerated rehabilitation. The group B received a standard rehabilitation protocol. Each group was evaluated prospectively with VAS, UCLA and Constant scores pre-op and during follow-up.

Results Both groups showed an increase of the scores, compared to the pre-op values. The VAS score of group A (PDGF) was 5.6 pre-op and 1.4 at 1 year. The VAS score of group B (no PDGF) was 5.2 pre-op and 1.4 at 1 year. The UCLA score of group A was 16 pre-op and 33.8 at 1 year. The UCLA score of group B was 16.7 pre-op and 32.9 at 1 year. The Constant score of group A was 53 pre-op and 90.7 at 1 year. The Constant score of group B was 54.2 pre-op and 90.1 at 1 year. There were no statistically significant score differences in the results of the two groups ($p < 0.01$), with VAS, UCLA and Constant scores, at the final follow-up of 1 and 2 years.

Conclusions Our data suggest that the use of PDGF, compared to a standard repair, does not affect the quality of the rotator cuff repair at 2 years from surgery. Moreover the study suggests that the use of PDGF allows an accelerated rehabilitation program with ten days

of immobilization compared to four weeks as usually prescribed. Further studies should clarify the real effect of PDGF on the acceleration of the first phase of the cuff healing.

THE REGENERATION OF ROTATOR CUFF MASSIVE LESIONS: FROM BASIC RESEARCH TO THE DEVELOPMENT OF DECELLULARIZED BIOLOGICAL MEMBRANES FOR TISSUE-ENGINEERED BASED TECHNIQUES

R. Rotini¹, M. Fini², E. Bondioli³, P. Torricelli², G. Giavaresi², A. Marinelli¹, E. Guerra¹, D. Melandri³, A. Castagna⁴, R. Giardino²

¹Division of Orthopaedic Surgery (Section "B"), ²Laboratory of Surgical Preclinical Surgical Studies, Rizzoli Orthopedic Institute (Bologna-IT); ³Emilia Romagna Skin Bank, Ospedale Bufalini (Cesena-IT); ⁴Shoulder Surgery, Istituto Humanitas (Milan-IT)

The treatment of massive rotator cuff tears is still a major challenge in shoulder surgery and the study of biological Extracellular Matrix Materials (ECM) is gaining interest. Collageneous and not collageneous proteins and growth factors native to the ECM materials modulate the biology of tissue repair. Many commercially available biological ECM materials exist and promising results have been obtained in animal studies. Some clinical studies have not demonstrated improved healing or improved functional outcomes with the use of animal derived membranes [1, 2]. ECM source and origin, processing and sterilization techniques strongly affect the mechanical characteristics of ECM matrices and, consequently, the success rate in patients. Previously it was demonstrated that ECM membranes of human origin and dermal source stimulate tenocyte proliferation and ECM protein expression significantly more than a swine intestinal submucosa [3]. Therefore, in the present study, dermis from organ and tissue donors was decellularized (HDM) with an innovative technique and then studied by means of histology, SEM, cell viability tests. Mechanical tests and *in vitro* studies with tenocyte cultures were also performed. A commercially available human dermal matrix (GRAFTJACKET® – Maximum Force, GJ, Wright Medical Technology, Inc, Arlington, TN, USA, GJ) was used as golden standard membrane for comparison. The absence of cell components in HDM was demonstrated. The tensile strength of HDM, was higher ($p < 0.005$) for tensile test and for suture pull out test ($p < 0.0005$) than the one of GJ. Tenocyte proliferation of HDM was significantly lower than that of GJ while the synthesis of fibronectin was significantly higher when cells were plated with HDM than with GJ at 3 and 7 days ($p < 0.005$). The release of the inflammatory cytokine IL-6, was significantly lower for HDM than for GJ at 3 days ($p < 0.05$).

In conclusion, a biocompatible and bioactive ECM membrane from dermis of multiorgan donors was developed and will be useful for the treatment of massive rotator cuff tears.

References

1. Iannotti JP et al (2006) Porcine small intestine submucosa augmentation of surgical repair of chronic two-tendon rotator cuff tears. *J Bone Joint Surg Am* 88:1238–1244
2. Walton JR et al (2007) Restore Orthobiologic Implant: not recommended for augmentation of rotator cuff repairs. *J Bone Joint Surg Am* 89-A(4):786–791
3. Fini M et al (2007) In vitro study comparing two collageneous

membranes in view of their clinical application for rotator cuff tendon regeneration. *J Orthop Res* 25(1):98–107

MIDTERM RESULTS OF DISTAL RELEASE OF THE DELTOID FOR SYMPTOMATIC CUFF TEAR ARTHROPATHY IN ELDERLY PATIENTS

R. Scapinelli

University of Padua (Padua-IT)

Aim and Methods From September 2002 to October 2007, 22 patients (14 M, 8 F; mean age 73 years, range 53–78) were treated by distal release of the deltoid and recession of 1.5 to 2 cm of its humeral attachment. Seventeen were right shoulders. The purpose of this extraarticular operation [1–3] was to reduce subacromial contact pressure (gravitational decompression) and restrict the ascensional force of the deltoid. The assessment of the irreparability of the cuff tear was by preoperative MRI in all but 2 patients and confirmed through a mini-open inspection of the cuff in the same operative session in 7 patients. Passive mobilization of the shoulder was initiated since the first postoperative week, while active motion was delayed for 4 to 5 weeks. The subjective and objective results were evaluated by use of a modification of the shoulder rating scale of the UCLA. The mean postoperative follow-up was 52 months (range 12–72 months).

Results At follow-up, all but two patients were satisfied with the outcome. There were no complications. In 16 patients the results were graded as excellent, in 3 as good, in 1 as fair and in 2 as poor, in the latter the cuff tear involved also the subscapularis and there were major osteoarthritis changes. The most striking achievements were relief of pain obtained in 20 patients (total in 17, partial in 3) and an improvement of shoulder function, resulting in facilitation of movements (mainly active abduction and elevation) and better ability to perform routine activities of daily living. Muscular strength was never worsened in comparison with the preoperative status. In one half of the patients (11 out of 22) a slight reduction of the upward migration of the humeral head was evident on radiographic controls.

Conclusions Distal release of the deltoid is a simple and safe procedure for the treatment of intractable and unbearable pain and functional disability of the shoulder in low demand elderly patients with glenohumeral arthritis from massive irreparable cuff tears. The highly positive midterm results reported in this study suggest that the operation can be considered among the limited therapeutic options for cuff tear arthropathy, especially as an alternative to shoulder prosthesis or to muscle transfers.

References

1. Scapinelli R (2003) Il “release” deltoideo distale: una nuova opzione terapeutica per la “cuff tear arthropathy”. In: R. Scapinelli (ed) *Patologia e chirurgia dello spazio subacromiale*. CLEUP (Cooperativa Libreria Editrice Università di Padova), Padova, pp 129–136
2. Scapinelli R (2005) Distal release of the deltoid for the treatment of symptomatic cuff tear arthropathy: a preliminary report. *Techniques in Shoulder and Elbow Surgery* 6:98–107
3. Scapinelli R (2007) Distal release of the deltoid: a new treatment option for symptomatic cuff tear arthropathy. *Proceedings 10th International Congress of Shoulder and Elbow Surgery*, 17–20 September 2007, Costa do Sauípe, Bahia, Brazil, p 105

Author Index

A

Adravanti P. S28
Albanese C.V. S16
Alberghini M. S30
Alessandro L. S26
Amanti A. S87
Amato A. S73
Amato F. S34, S38
Ambrosio L. S82
Amendola L. S36, S78
Ampollini A. S28
Anderson J.A. S28
Andreacchio A. S30
Anekstein Y. S34
Angeloni M. S4
Angrisani C. S22
Antinolfi P. S87, S88
Aprato A. S17
Aquino A. S22, S80
Argento G. S62
Arrigoni P. S89
Artiaco S. S75, S81, S82
Assom M. S43, S54
Astarita E. S75
Attingenti P. S45
Aulisa A.G. S39, S79
Aulisa L. S39, S72
Azzoni R. S79

B

Bakaloudis G. S36
Balboni E. S44
Baldini A. S28, S46
Bancale R. S14
Bandiera S. S78
Banfi G. S88
Barbanti B. S46
Barbieri C. S84
Barbieri E. S77
Barnaba S. S40
Barresi C. S18, S66
Bartolozzi P. S18, S25, S51, S57, S60
Baschieri U. S21
Basile A. S64, S84, S85
Battiston B. S32, S52, S75, S81, S82
Beatrice P. S11
Beaufils P. S47
Bélot N. S47
Beltrame A. S70
Beltrami G. S32
Belvedere C. S28
Benazzo F. S27
Benedetti M.G. S28
Berlusconi M. S23, S50
Bernardi A. S52
Bevoni R. S58

Biagini R. S78
Bianchi G. S30
Biasibetti A. S19, S23
Biggi F. S3, S14, S35, S59
Bignardi C. S54
Bini A. S51
Bistolfi A. S44, S46
Blonna D. S43, S50, S54
Boisrenoult P. S47
Bolzani F. S21
Bonalummi M. S22, S49, S52
Bonasia D. S42, S43, S54
Bonasia D.E. S11, S43, S50
Bondi L. S84
Bondioli E. S90
Bono B. S22
Boriani L. S36
Boriani S. S35, S36, S78
Bosco G. S76
Botti F. S7
Bove F. S41
Brach del Prever E.M. S29
Bruè S. S88
Brunelli G. S32
Bruni D. S26
Bruzzone M. S2, S11, S42, S43
Buda R. S48, S57, S58
Bufalini C. S8
Busilacchi A. S1
Buzzelli N. S9

C

Cabitz P. S89
Cadossi R. S30
Calabrò G. S66
Calabrò, T. S76
Caldora P. S15, S48, S78
Callea C. S2
Campagnolo M. S39
Campanacci D. S78
Campanacci D.A. S32, S33
Campochiaro G. S53
Canali A. S53, S84
Candela P. S18
Cannata G. S40, S60, S83
Canu C. S14
Capanna R. S32, S33, S78
Capitani D. S19, S20, S22, S49, S50, S52, S58
Capone A. S18
Cappuccio M. S35, S36, S78
Caraffa A. S88
Caranzano F. S17
Carnielli F. S55
Cartesegna P. S81
Caruso G. S22, S80
Casella F. S15, S17, S18, S34, S38, S41, S66

Castagna A. S90
Castagnini L. S21
Castelli F. S20, S49, S50, S58
Castoldi F. S2, S11, S42, S43, S50, S54
Catalano F. S7, S82
Catani F. S28
Catena N. S79
Causero A. S70
Cavaciocchi M. S48
Ceccarelli S. S44
Celi M. S42, S83
Cenna E. S44
Cerciello S. S12, S45, S47, S63, S87
Cerocchi I. S42
Cerulli G. S87, S88
Cerulli-Mariani P. S28
Cerveri P. S12
Cervone R. S22
Cesari E. S1
Chelo C. S59
Cherubino P. S51
Chiara O. S58
Chiodini F. S23, S50
Ciampa F.P. S10
Ciardelli G. S82
Ciarpaglini G. S15
Cigala F. S31
Cigni S. S69, S81
Cinotti G. S10, S11, S47
Cipullo M. S25
Ciriello V. S17
Cittadini A. S40
Colantonio V. S64
Collo G.L. S43, S50
Colopi S. S84
Colzani G. S46
Confalonieri N. S12
Conforti L. S32
Conforti L.G. S52, S75, S81
Conteduca F. S10, S27, S62, S75
Conti C. S17
Corbella M. S3
Corradini C. S64
Corrado E.M. S75
Cosmi F. S70
Costa A. S18
Croce A. S13
Crova M. S44, S46

D

D'Angelo F. S75
D'Angelo G. S21
D'Antimo C. S14, S59
D'Antona D. S68
D'Arienzo M. S68, S82
D'Arrigo C. S16
Daghino W. S17

Dagna M. S19
 Dalla Pria P. S33
 De Biase P. S32, S33, S78
 De Carli A. S62, S66
 de Girolamo L. S88
 De Iure F. S35, S78
 De Marchi A. S29
 De Martino I. S43, S44
 de Mattheis A. S23
 De Momi E. S12
 De Salvo F. S36
 De Sanctis N. S6, S30
 Del Ferraro L. S64
 Del Prete F. S22
 Del Prete S. S22
 Del Sasso L. S51
 Delcogliano M. S65
 D'Eletto G. S37
 Della Rotonda G. S40
 Denaro V. S40, S67, S68, S89
 Deponti D. S73
 Deriu L. S65, S67, S73, S74, S87
 Dettoni F. S11, S42, S50, S54
 Di Benedetto P. S70
 Di Caprio F. S48, S58
 Di Cave E. S64
 Di Fabio S. S3, S14, S55, S59
 Di Martino A. S26
 Di Mento L. S50
 Di Sanzo V. S62
 Difino A. S21
 Dimento L. S23
 Diotti E. S62
 Dolfin M. S23
 Domeneghini C. S74
 Donini M.T. S53, S84
 Donthineni R. S35
 Doria C. S18
 Dovesi A. S30
 Drocco L. S46
 Dworschak P. S13

E

Ennas F. S37, S39
 Ensini A. S28

F

Fabbri F. S21
 Fabbriani C. S65, S67, S73, S74, S87
 Fabris Monterumici D.A. S35, S71
 Facchini C. S21
 Facchini R. S6
 Fagetti A. S39
 Falciglia F. S7, S80
 Falcone G. S67
 Faldini A. S51
 Faletti C. S29
 Falez F. S9, S15, S17, S18, S34, S38, S41, S66
 Fantasia F. S88
 Fargnoli G. S37

Fargnoli S. S37
 Favetti F. S15, S17, S18, S41, S66
 Favuto M. S19
 Febo A. S7, S69
 Feliciangeli A. S28
 Ferrara O. S82
 Ferrari E. S10, S11, S47,
 Ferrari S. S77
 Ferraro A. S76, S77
 Ferraro G. S40
 Ferretti A. S10, S16, S62, S66, S75
 Ferro A. S43
 Ferruzza M. S68
 Filardo G. S65
 Finardi E. S8, S69
 Fini M. S30, S90
 Fiore A. S19
 Floman Y. S34
 Folliero A. S84
 Forconi F. S11
 Franceschi F. S67, S68, S89
 Franceschini G. S13
 Franchi F. S36
 Francione V. S14
 Frascari F. S62, S63
 Fraschini G. S46, S74
 Fraschini G.F. S73
 Frasso R.F. S36
 Fregni U. S21

G

Galasso O. S40
 Gallo A. S19
 Gallon A. S37
 Galvano N. S68, S82
 Ganau M. S37, S39
 Gasbarra E. S42, S83
 Gasbarrini A. S36, S78
 Gasparini G. S43, S44
 Gaviano A. S37, S39
 Gentilucci F. S31
 Geuna S. S75
 Ghera S. S14
 Ghermandi R. S48, S57
 Giacobbe M. S43, S44
 Giacometti Ceroni R. S3
 Gianni D. S73
 Giannini S. S28, S48, S57, S58
 Giardella A. S23
 Giardino R. S90
 Giavaresi G. S90
 Gigante A. S1
 Gigante D. S44
 Gigli M. S77
 Gino G.C. S29
 Giordano G. S26
 Giordano M. S7, S79, S80
 Giuliani P. S10
 Gloria A. S82
 Gobbi A. S65
 Gosheger G. S77
 Grasso A. S67

Graziano E. S44
 Greco A. S47, S65
 Greco F. S1, S44
 Grecomoro G. S76
 Grippi G.M. S83
 Grosso E. S23
 Guarino S. S45
 Guarracino R. S15, S48, S78
 Guerra E. S90
 Guerra L. S10
 Guida G. S51
 Guidi E. S53
 Guido G. S18
 Guzzanti V. S7, S39, S79, S80
 Guzzini M. S8

H

Hoglievina M. S70

I

Iacono F. S26
 Iacopinelli M. S53
 Ianni L. S78
 Iervolino G. S66
 Indelli P. S46
 Iolascon G. S51
 Iorio R. S10, S27, S62
 Ippolito E. S7
 Ippolito V. S78
 Iundusi R. S40, S42, S83
 Izzo V. S65, S67, S73, S74, S87

J

Jelmoni G.P. S18

K

Kalyvas J. S28
 Koenig A. S23
 Kon E. S65

L

La Maida A. S22, S58
 Labianca L. S62
 Lagalla F. S44, S46
 Lamaida G.A. S20
 Lambiase A. S31
 Lazzara D. S22, S80
 Leardini A. S28
 Learmonth I. S16
 Lecce D. S83
 Lentini R. S76
 Lettera M.G. S25
 Lillo M. S31, S53
 Linari A. S29
 Lisai P. S18
 Lisanti M. S18
 Liuzza F. S77
 Lo Presti M. S26

Logoluso N. S29
 Logroscino C.A. S36, S72
 Logroscino G. S17, S72
 Lollino N. S50
 Longo U.G. S67, S68, S89
 Loreti A. S84
 Lovato M. S62
 Lucente L. S15, S51
 Lucioli N. S10, S11, S47
 Lup D. S15, S48, S78
 Luppino S. S21
 Luzon D. S27

M

Macaione A. S76
 Maccabruni A. S5
 Maccauro G. S4, S23, S31, S77
 Macchi F. S16
 Maddaluno L. S31
 Maestri B. S62
 Maffulli N. S67, S68, S89
 Magliocchetti Lombi G. S4, S17
 Magliozzi B. S26
 Magnan B. S18, S57, S60
 Magni M. S30
 Maiello A. S42
 Maiotti M. S57
 Maistrelli G.L. S11
 Maleci A. S37, S39
 Manca M. S53
 Mancini I. S33
 Mandrile R. S82
 Manfredini G. S53, S84
 Manfredini L. S46, S73, S74
 Manunta A.F. S71
 Manzini C. S18, S62
 Manzotti A. S12
 Manzotti S. S1
 Marcacci M. S26, S65
 Marcheggiani Muccioli G.M. S26
 Marchettini D. S23, S50
 Marconi A. S41
 Margheritini F. S62, S63
 Mariani P. S63
 Mariconda M. S40
 Marinelli A. S90
 Marino M. S25
 Marinoni E. S20, S49
 Marmotti A. S2, S42, S43, S50
 Marras F. S71
 Martinelli B. S70
 Martucci E. S18
 Mascello D. S5
 Massai F. S10, S27
 Massazza G. S44, S46
 Massè A. S17
 Masse A. S19
 Massoni C. S57
 Mastantuoni G. S39, S79
 Matera R. S73
 Matteotti R. S17, S23
 Mauthe Von Degerfeld M. S2

Mazzetti M. S36
 Mazzoleni L. S19, S22, S49, S52
 Mazzotta C. S12, S45, S47, S63, S87
 Mazzuca M. S41
 Meani E. S29
 Mecchia F. S68
 Melandri D. S90
 Melegati G. S88
 Mercuri M. S30, S76, S77
 Merolli A. S7, S82
 Messuti L. S77
 Migliavacca N. S51
 Miglietta C. S71
 Milano C. S40
 Milano G. S65, S67, SW73, S74, S87
 Milia F. S18
 Mimmo P. S37
 Minio Paluello G.B. S63
 Minniti De Simeonibus A.U. S84
 Mirabile L. S36
 Miranda M. S52
 Mirovsky Y. S34
 Modonesi F. S62
 Molayem I. S4
 Monaco E. S62
 Montalti M. S76, S77
 Montaperto C. S65
 Monteleone L. S21
 Montironi F. S12
 Mora R. S5
 Moreschini O. S2
 Morici F. S28
 Mosetto F. S23

N

Nalbone L. S76
 Nasi F. S8
 Nasto L. S72
 Natarelli A. S10
 Nicoletti S. S28
 Nitri M. S65
 Nizami E. S15, S48
 Nizegorodcew T. S23, S77
 Nogherotto P. S70

O

Oggiano F. S37, S39
 Oggiano L. S36, S72
 Olivero C. S44, S46
 Ometti M. S13
 Orlando N. S44

P

Pace F. S19, S22, S49, S52
 Paderni S. S36, S78
 Paderno M. S78
 Pagano E. S17
 Pagliara T. S14, S59
 Pagnotta G. S5
 Pagnuzzato C. S3

Pala E. S76
 Palieri G. S16
 Paliotta V.F. S26
 Palmieri D. S10
 Palmieri G. S23
 Palomba M. S53
 Palombi P. S26, S31, S53
 Panarella L. S47
 Pandorf T. S16
 Panegrossi G. S15, S18, S41, S66
 Panterli M.G. S45
 Papalia I. S75
 Papalia M. S17, S18, S34, S38, S41, S66
 Papalia M. S15, S51
 Papapietro N. S40
 Parisi S. S50
 Parlato A. S68, S82
 Parravicini P. S64
 Pasquetto D. S25
 Passalacqua R. S60
 Pautasso P. S17
 Pavlov H. S28
 Pavolini B. S60
 Pazzaglia U.E. S3
 Pedrotti L. S5
 Peirone B. S2
 Pennati G. S71
 Peretti G. S46
 Peretti G.M. S73, S74
 Perisano C. S39
 Persiani P. S4
 Persico G. S25
 Perticarini L. S42
 Perugia D. S8
 Petricca P. S66
 Petrini A. S22, S80
 Pezzillo F. S23, S77
 Piccioli A. S26, S31, S53
 Piconi C. S4
 Pigni M. S48
 Pilato G. S51
 Pipino G. S10
 Pisanu F. S71
 Piscitelli R. S73
 Pola E. S1, S72
 Portaluri M. S40
 Pozzi A. S73, S74
 Pozzi G. S42
 Pressacco M. S33
 Prestamburgo D. S39
 Prezioso V. S77
 Preziuso L. S80
 Prinzo L. S66
 Proietti L. S36
 Puddu G. S47

R

Raimondo S. S75
 Randelli P. S89
 Ravaoli S. S84
 Regis D. S18
 Richeldi G. S21

Ripani F.R. S63
 Rizzello G. S67, S68, S89
 Rocchi L. S82
 Rodia F. S31, S53
 Romanini L. S4
 Romanò C.L. S29
 Romanò D. S29
 Ronchetti M. S30
 Rondinella F. S6
 Rosa D. S45
 Rosa M.A. S31
 Rossetti F.R. S7
 Rossi B. S77
 Rossi C. S75
 Rossi P. S2, S42, S43
 Rossi R. S2, S11, S42, S43, S50, S54
 Rossi S.M.P. S27
 Rosso F. S46
 Rotini R. S90
 Ruffilli A. S57
 Ruggieri P. S76, S77
 Ruggiu A. S18
 Ruo A. S64
 Ruosi C. S25, S33
 Russo A. S45
 Russo S. S75
 Ruzzini L. S40, S67, S68, S89

S

Saccardi R. S33
 Sacco F. S19
 Sadile F. S31
 Sala F. S19, S20, S49, S50, S58
 Salvadori C. S36
 Salvatore M. S67
 Salvatori S. S67
 Samaila E. S57, S60
 Sandri A. S18
 Santaiti D. S12, S45, S47, S63, S87
 Santoleri L. S72
 Santori F.S. S14, S16, S42
 Santori N. S42
 Sassi D. S21
 Savarese E. S7, S69
 Scapinelli R. S90
 Scarabello I. S23, S50
 Scaramuzzo L. S36
 Scarchilli A. S13, S64
 Scardocci A. S73
 Scarponi R. S38, S54
 Scarponi S. S38, S54
 Schiavilla V. S16, S41

Schiavone Panni A. S12, S45, S47, S63, S87
 Schipani D. S64
 Schoenhuber H. S88
 Sciarretta F.V. S64
 Scoccianti G. S32
 Scotti C. S74
 Sculco T.P. S28
 Secondulfo V. S40
 Sénès F.M. S79
 Sennì C. S87
 Servodio Iammarrone C. S4, S75
 Servodio Iammarrone F. S4
 Sessa V. S11
 Sgambato A. S40
 Sinigaglia R. S34, S35, S71
 Sironi S. S42
 Sisto R. S23
 Smorgick Y. S34
 Sosio C. S46
 Spagnolo R. S19, S20, S22, S49, S50, S52, S58
 Speciale R. S37
 Speranza A. S16
 Spinelli S. S65, S73, S74
 Spoletini M. S66
 Squarzina P.B. S21
 Stojimirovic D. S11
 Stopponi M. S84
 Stradiotti P. S42
 Surace M.F. S39, S51

T

Taglialatela E. S22
 Taglioretti J.M. S72
 Tajana G. S33
 Tangari M. S61
 Tanturri N. S34, S38
 Tarantino F. S21
 Tarantino U. S18, S40, S42, S47, S60, S83
 Tarone G. S2
 Tartarone M. S12, S45, S47, S63, S87
 Tempesta V. S40
 Terzi S. S36
 Testa D. S44, S46
 Teti A. S9, S73
 Tidu L. S18
 Tomasi A. S68
 Topa G. S14
 Toro A. S66
 Torricelli P. S90
 Tos P. S32, S52, S75, S81
 Toscano A. S77

Tranquilli Leali P. S18, S71
 Trentani F. S2
 Trentani P. S2
 Trevisani S. S3, S55
 Trinchese G.F. S66
 Tripodi F. S66
 Tripoli E. S53, S84
 Tudisco C. S7, S69
 Turturro F. S25

V

Vaccarisi D.C. S10
 Vadalà A. S62, S66
 Valentini R. S70
 Valentinotti U. S20, S58
 Vannini F. S57, S58
 Vasario G. S82
 Vasso M. S12, S45, S47, S63, S87
 Velluti C. S59
 Venosa M. S17, S73, S74
 Ventura A. S31, S53
 Vercillo F. S87
 Verdenelli A. S44
 Verdoia C. S64
 Verona M. S59
 Veronesi E. S33
 Versari P. S64
 Vetrano M. S16
 Vicario A. S51
 Villani C. S4
 Viola G. S57, S60
 Visci F. S77
 Vitali A. S80
 Vitali M. S46
 Vitari F. S74
 Volpato F. S41
 Volpi P. S88

Z

Zachos A. S18
 Zaffagnini S. S26, S65
 Zagra L. S3
 Zampar G. S66
 Zanolungo M. S8, S69
 Zanotta M. S64
 Zanolotti G. S18
 Zanzotto E. S66
 Zapparoli C. S21
 Zarattini G. S3
 Zerbi A. S42
 Zoccola K. S23