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IN-DEPTH ORAL PRESENTATIONS

LOWER LIMBS DEFORMITIES

Non-invasive distal femoral expandable endoprosthesis in musculoskeletal tumors: a novel approach for dismetry in adult limb salvage surgery

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Introduction Authors describe the application of a non-invasive extendible endoprosthetic replacement in a skeletally-mature patient undergoing revision for failed joint modular prosthesis with resultant limb dismetry after malignant disease. This prosthesis was firstly developed for tumoral surgery in skeletally-immature patients. Authors have now adapted it to correct dismetry in revision procedures of adults. Authors present the mid-term results of a female patient who had this procedure after multiple previous reconstructive operations.

Methods The essential components of this prosthesis employed are a magnetic disc, a gearbox and an internal screwdriver which allows painless lengthening of the prosthesis using the principle of electromagnetic induction. The age of the patient at last surgery performed with extendible endoprosthetic replacement was 53 years. She had previously undergone two open procedures on the affected limb before revision with non-invasive extendible endoprosthesis. General health status was measured pre-operative and at last follow-up with SF-36 and QoL scores. In the same time lower limb function was measured with the Lower Extremity Functional Scale and lower limb disability with AAOS Lower Limb Questionnaire.

Results The length gained was 24.6 mm requiring 82 lengthening episodes performed in the outpatient department. At last follow-up (48 months) the patient was able to perform daily activities with the help of only one crutch for outdoor walking.

Conclusions To our knowledge this is the first case of non-invasive extendible endoprosthetic replacement in a skeletally-mature patient performed in Italy.

Eight plate guided growth correction of dismetabolic deformities in children: our experience

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Introduction In the paediatric population dismetabolic lower limb malalignment is prevalently associated to some specific diseases such as nutritional rickets (NR), renal osteodystrophy (RO) and mucopolysaccharidosis (MPS). Sometime these deformities are severe and evolutive and require that surgical correction.

Methods Our experience concerns 17 growing patients presenting lower limb deformities treated performing surgical emi-epiphysiodesis by 8-plates (guided growth); 8 of these patients had RO, 5 by MPS and 4 by NR. In renal osteodystrophy the youngest patient aged 2 and the oldest 14 years at surgery. In MPS this age was between 6 and 10 years, in NR between 3 and 13 years. In children with RO there was a valgus deformity in all but one patient. In NR there were 3 *genu valgus* and one *genu varum*. In all these patients *genu varum* was observed in the youngest people. All MPS patients presented a typical valgus knee. The

most severe deformities were observed in children with chronic renal failure (valgus deformity oscillating between 12° and 45°). Mild deformities, between 10° and 15°, were observed in MPS patients.

Results A stable and satisfactory correction of the limb deformities was obtained in 4/8 of patients with RO (50 %). About the four patients with not satisfactory results, there was one with relapse of valgus deformity, one with incomplete correction (a corrective tibial osteotomy was performed at the end of growth), one with severe hyperparathyroidism showing multiple and multifocal deformities, and finally one girl with persistent deformity and femoral shortening due to an unexpected iatrogenic epiphysiodesis. The breakage of a titanium screw was registered at the removal of a femoral 8-plate. All NR and MPS patients had a satisfactory correction without any complication. In all MPS patients the correction was very slow according to their typical short stature.

Discussion Relapse of the deformity, requiring a second procedure, may occur in chronic renal failure. Besides in renal osteodystrophy, when the deformities are multiple and prevalently diaphyseal, the restoration of mechanical axis and the correction of the may be only partial. For these reasons RO patients must be strictly monitored requiring periodical follow-up. The very low speed of correction in MPS patients recommend an early surgical procedure in this category of patients.

Conclusions Emi-epiphysiodesis (8-plates guided growth) generally allows satisfactory correction of paediatric dismetabolic deformities of lower limbs. Because of its less invasiveness this procedure should be preferred to the classic corrective osteotomies.

The unicompartmental knee replacement in major deviations axial of lower limb

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Introduction After evaluation of the obvious advantages in terms of post-operative recovery, survival and patient satisfaction, in recent years many surgeons have approached on the use of unicompartmental knee arthroplasty. From an analysis of the literature that still seems to vary among surgeon users of unicompartmental prosthesis, the limit as an indication, in degrees, of the axis of the leg beyond which there is no more indication to a unicompartmental prosthesis. According to many surgeons, in fact, there would be not more space for a unicompartmental implant, in the axial deviations in varus or valgus above 10°.

Methods We analysed 300 unicompartmental (medial or lateral) of the knee implanted between January 2008 and June 2012, selecting them on the basis of preoperative axial deviation and created two study groups: the first group of 150 patients with varus-valgus pre-operative greater than or equal to 10°, and a control group of equal size with varus-valgus preoperative less than 10°. The results were assessed by the KSS.

Results The results of the KSS were similar in the 2 groups, with no statistically significant differences, as well as the degree of patient satisfaction, which indeed was slightly higher in the group with deviation greater than 10°. Although the percentage of patients had incurred revision has been shown in both cases negligible.

Discussion The results certainly depend on a correct surgical technique, especially in patients with a greater axial deviation, which is crucial for the success of the intervention and patient satisfaction, the correction of axial deviation of the limb. The numerous casuistry is possible through the application of such indication extended for many years, given the excellent results obtained.

Conclusions The limit to the indication in unicompartmental for axial deviations up to 10° , is now obsolete. The medium-term results we have obtained, in comparison with a control group, indicating that it is necessary to revise this limit upward; indeed, if possible, bring it down finally: who prevents us from implanting a prosthesis in varus-valgus of 20° , if we have the chance? Of course, to make these surgeries, cannot be ignored by an excellent surgical technique.

The effect of high tibial osteotomy: patellar height modification and inclination of tibial plateau

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Introduction The high tibial osteotomy (HTO) is a standard procedure in treatment of varus knee deformity in patients no older than 60 years of age. HTO allows a considerable pain relief without compromising patients' activity level. HTO affects both, frontal plane resulting in a lateral shift of the mechanical axis, and sagittal plane modifying patellar height and antero-posterior inclination of tibial plateau (tibial slope or stop). These two parameters could influence knee and patellar stability and involve a later knee replacement surgery. The aim of our work is to determine how HTO effects patellar height and tibial slope.

Methods Two groups of 40 patients each, were compared. In each group, age, degree and type of deformity were homogeneous. All patients suffered from tibio-femoral arthrosis and underwent high tibial osteotomy surgery. Group 1 underwent closing wedge osteotomy procedure (CWO) with VCO plate; group 2 underwent opening wedge osteotomy procedure (OWO) with steel Puddu plate implant. Patellar height was measured by Caton method. To determine tibial slope, the angle between the tangent to the medial tibial plateau and the perpendicular direction to tibial proximal anatomical axis was measured.

Results Pain relief, mobility, articular stability and radiographic results on frontal plane correction were similar in both procedures. Although CWO theoretically causes an increase in patellar height, the modification was not significant (Caton index before surgery 0.98 ± 0.128 ; after 1.01 ± 0.185); unlike patella height lowering following OWO procedure (Caton index before surgery 0.99 ± 0.134 ; after 0.91 ± 0.125). In OWO procedure the decreased distance of the patellar tendon from the joint line is caused by the lowering of the antero-tibial tuberosity from the joint line.

Discussion The lacking of patellar height increase in CWO should be caused by the contraction of patellar ligaments. However, OWO should be avoided in case of lowly patella. With CWO tibial slopes usually decreased as a result of anterior and posterior osteotomy closure (tibial slope before surgery $7.5^\circ \pm 4^\circ$; after $3.6^\circ \pm 5^\circ$), while OWO tend to increase tibial slope widening the front party (tibial slope before surgery $7.3^\circ \pm 4^\circ$; after $8^\circ \pm 5^\circ$). Therefore CWO is a more suitable option in case of LCA injury, while OWO should be preferred in case of LCP injury.

Conclusions Patellar height decrease and modification of tibial slope after high tibial osteotomy could negatively influence knee biomechanics and influence a later knee replacement surgery.

HIP

Direct anterior vs. postero-lateral approach for hemiarthroplasty in proximal femoral fractures. A prospective randomized study of 50 patients

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Introduction The direct anterior approach for hip arthroplasty is emerging as a valid alternative to other surgical approaches, that are diffusely adopted for this procedure. The aim of this prospective randomized study was to compare the direct anterior with the postero-lateral approach in hip hemiarthroplasty for intracapsular fractures of the proximal femur.

Methods A consecutive series of 50 patients was divided into two randomized groups, each composed of 25 subjects: group A, direct anterior approach (7 men, 18 women, mean age $86.60 \text{ years} \pm 6.042$); group B, postero-lateral approach (7 men, 18 women, mean age $86.04 \text{ years} \pm 6.195$). The inclusion criteria were: age ≥ 70 years, traumatic intracapsular fractures of the proximal femur with indication to hemiarthroplasty, ability to walk before the trauma, ASA score from 1 to 4. Surgical time, intra- and post-operative complications were recorded for every patient. The following parameters were evaluated at 3 days, 1, 3 and 6 months after surgery: pain (NRS), functional recovery (ADL scale) and recovery of deambulation (CAS scale).

Results Forty-three patients were evaluated at the 6-month follow-up (6 died, 1 was untraceable). Post-operative complications included 5 heterotopic ossifications (1 in group A and 4 in group B), 1 periprosthetic fracture (A) and 1 septic mobilization (A). The average surgical time was 5.8 min longer in group A than in group B ($p = 0.016$). At 3 days and at 1 month after surgery, pain perception was higher in group B ($p = 0.001$ and 0.023). Functional recovery was comparable in the two groups, but only in group A the ADL scores at 6 months did not show significant differences with the scores before the trauma.

Discussion The surgical approach does not play a critical role in the prognosis of elderly patients undergoing hip hemiarthroplasty for fractures of proximal femur. Despite a longer surgical time, the anterior approach was less painful in the first weeks after surgery and less affected by heterotopic ossifications. Conversely, the postero-lateral approach seemed to be more suitable for cementation of the femoral stem.

Conclusions The choice of the surgical approach is influenced by the individual experience of the surgeon. The direct anterior approach is advantageous from the anatomical point of view, but requires a non-negligible learning curve as well as some technical adaptations for stem cementation.

Radiographic changes after arthroscopic treatment of femoro-acetabular impingement

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Introduction One of the most common causes of groin pain in young athletes is represented by femoro-acetabular impingement; hip arthroscopy is now recognized worldwide as a treatment of choice for this condition. Arthroscopic procedure is associated with characteristic post-operative radiographic changes of the main parameters in AP radiograph and frog leg view of pelvis, closely correlated with clinical outcomes of patients. The aim of this work is to evaluate analytically postoperative radiographic changes in FAI treated by arthroscopy.

Methods Forty-five consecutive patients with a clinically and radiographically documented FAI were treated in our institute. Pre-operative and post-operative radiographs of 38 patients (mean age 40.8; 22 M and 16 F) have been reviewed. The radiographic follow-up of the controls has been an average of 12.7 months. The radiographic parameters that were evaluated in the preoperative and postoperative radiographs, using the Philips EBW software, are represented by lateral centre edge angle, α angle and offset of the neck.

Results The pre-operative and post-operative radiographic study showed a statistically significant changes of two parameters: α angle, with its significant reduction from an average of 69.7° pre-operatively to an average of 50.7° at follow-up (mean reduction of about 9°); similarly there has been an increase in the offset of the neck from an average of 5.44 mm preoperatively to an average of 7.76 mm at follow-up (mean increase of 2.32 mm). However, no significant change was observed in the LCE angle that was virtually unchanged in the preoperative and postoperative evaluation (pre-LCE angle = 33.5°, post-LCE angle = 33.1°).

Discussion The arthroscopic treatment of FAI is associated with a statistically significant changes of two radiological parameters: offset of the neck and α angle, whereas it is not observed significant changes in the LCE angle, even gestures of osteoplasty of acetabulum may be associated to the procedure. In our patients, as demonstrated in the literature, reduction of α angle and increase of the offset of the neck is correlated with clinical findings, in particular increase in internal rotation and reduction of pain.

Conclusions Arthroscopic treatment is able to treat certain anatomical abnormalities, as evidenced by pre-operative and post-operative radiographic findings, improving considerably the quality of life of patients and reducing the possible evolution to osteoarthritis of the hip.

Short-term results of surgical treatment of adhesions capsular-labral and capsular-bone in the young adults hip

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Introduction Femoro-acetabular impingement (FAI) has established in the last years as a cause of osteoarthritis in youth people. With the development of various techniques also complications are raised. The capsular-labral adhesions are one of the most frequent complications that can generate dolour, discomfort and decreased mobility in patients.

Methods From July 2003 to December 2012 were treated 814 patients with diagnosis of FAI. Among these, 33 patients were diagnosed of capsular-labral adhesions. From these group, 20 were operated with arthroscopic technique and 13 with mini-open technique. On average, the second-look surgery has been realized at 7.3 months post-operatively. The results are evaluated with the clinical examination, range of motion, NASH and Dexeus Combined Score (DCS).

Results The mean follow-up was 3.2 years (range 1–8 years). The value of NASH has gone from a 51.5 (R 29–61) to 83.2 points (R 6–93.1) at last follow-up. The DCS showed a satisfactory results in 84.8 % of patients (28). Capsular-labral adhesions has been found in 28 patients (84.8 %) and in particular in the area corresponding to the anchors and in the region of the head neck junction in all patients with CAM hypocorrection (30.3 %).

Discussion Adhesions are a problem still not fully described in the literature. It seems that they can depend on several factors: endogenous, exogenous as well as an incorrect program of postoperative rehabilitation, hypocorrections, hypersensitivity to the suture material and autoimmune factors. The incidence may be higher than that reported in our study.

Conclusions Diagnosis and early treatment of adhesions in the young adults' hip appears to be effective with satisfactory short-term results in the majority of patients.

Revision surgery of femoro-acetabular impingement. Causes for re-operation and treatment strategy

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Introduction Femoro-acetabular impingement (FAI) is a pathological condition recognized recently. Alongside the growth of the interest in this condition, there is an expansion of the execution of the surgical treatment, with a corresponding increase in the absolute number of surgical failures. Possible complications seem also recognized, and a part of them is related to the surgical learning curve. Actually the field of revision surgery is still unknown. We report our experience in 34 cases of revision surgery, trying to define a diagnostic process and an appropriate surgical strategy.

Methods We describe the causes that led to reoperation between 2009 and 2013 in 34 patients with prior history of FAI surgery. We discern between errors of indication and complications related to the disease or to poor surgical technique. Among the errors of indication there was 7 cases of osteoarthritis related to FAI cases operated in Toennis stage 3, that required prosthetic surgery, and 2 cases of labral suture failure in dysplastic patients, requiring a three-dimensional acetabular osteotomy associated to labral re-suture. Among the complications related to the disease we re-operated 6 cases for capsular-osteoplastic and labral adhesions, managed by arthroscopic debridement. In the 20 remaining cases the main cause of failure was the hypocorrection on the femoral side, associated with neglected acetabular osteoplasty and/or subtotal labrectomy. All but one of these cases were re-operated by a minimally invasive anterior open approach. A single case was re-operated by surgical safe dislocation. The surgical revision consisted on femoral re-osteoplasty, acetabular osteoplasty, and labral reconstruction in 18 cases as following: ileo-femoral lateral ligament (8), semitendinosus tendon (4), fascia lata (2). In 2 cases, was used an allogenic cryopreserved labral transplant, one of which during surgical dislocation.

Results The clinical and functional results were satisfactory in all patients, recorded by WOMAC score in cases of prosthetic cases, and by the NAHS in patients operated for other techniques.

Discussion With the expansion of recognition and surgical treatment of FAI it is reasonable expect an increase in the number of surgical revision. A correct selection of the patient, as pre-operative planning are determining factors in the outcome of treatment. Likewise, the planning of revision surgery must be comprehensive, and aims to correct all the factors previously disregarded.

Conclusions Revision surgery of FAI is indicated in surgical failures due to error of indication, planning and surgical technique, as well as in case of standard complications related to the disease.

Heterotopic ossification following hip arthroplasty: a comparative study about its development with the use of three different kinds of implants

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Introduction Heterotopic ossification is the presence of bone in soft tissues where it physiologically doesn't exist. It is one of the most common complications following hip joint replacement surgery with negative influence on the patients' quality of life. A variety of risk factors have been identified to date but etiopathogenesis is still uncertain. So far, the therapy which has shown efficacy is the preventive one, with NSAIDS and radiotherapy. Once ossifications have developed, surgical resection is needed. The aim of this study is to record the incidence of heterotopic ossification by different risk factors, verifying literature agreement. The final purpose is to identify high-risk groups of patients and possible preventive actions to decrease the incidence of heterotopic ossifications.

Methods We studied 651 patients undergoing hip joint replacement considering three kinds of implants (total hip arthroplasty ceramic–ceramic, TriboFit, endoprosthesis). Each patient has been analysed for ectopic ossification development by: age, gender, comorbidity, diagnosis, presence of previous ossifications, surgical approach, surgeon, kind of implant. Within the population which developed heterotopic ossifications, data were assessed for correlation with severity of ossification graded following Brooker's classification.

Results The overall incidence of heterotopic ossification was 59.91 %. The factors increasing the incidence at the univariable analysis were: male gender, young age, diagnosis of coxarthrosis compared to femur neck fracture, presence of previous heterotopic ossifications, lateral approach as opposed to anterior-lateral one, arthroprosthesis ceramic–ceramic and TriboFit compared to endoprosthesis. Heterotopic ossification has been strongly influenced by the surgeon. During multivariable analysis, the presence of previous ossifications and the kind of implant showed to be independent risk factors for the development of heterotopic ossifications. Analyzing the population which developed heterotopic ossification, we found that the severity of ossification by Brooker was influenced by: gender, surgeon, kind of implant.

Discussion In agreement with literature, the following risk factors have been confirmed: previous heterotopic ossifications, kind of implant, surgical approach, diagnosis of coxarthrosis compared to femur neck fracture, surgeon, male gender. In particular, Hardinge-Bauer and Watson-Jones surgical approaches and total hip

replacement ceramic–ceramic and TriboFit implants increase significantly the development of heterotopic ossifications.

Conclusions Our data show that the orthopaedic surgeon should prefer minimal-invasive surgical approaches and implants. Comparing our experience to literature, it's clear the need to introduce a preventive treatment and we suggest to perform a controlled randomized study as a valid aid to choose the most adequate therapeutic option for each patients' category.

BASIC RESEARCH

Preliminary results of the study of reduced gravity osteoporomalacia on human

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Introduction The osteoporomalacia by loss of gravity is the most important obstacle to the permanence of man in space. The astronauts are affected by a loss of bone mass comparable with systemic osteoporosis in post-menopausal women. This loss of bone mass was measured quantitatively and qualitatively before and after the flight, but during the missions were never studied the variations of the main metabolites of bone due to the difficulty of data collection. Another environment characterized by reduction of the gravity is underwater environment and may represent a more accessible model for the study of bone metabolism in reduction of gravity.

Methods We studied six athletes divers, three males and three females, mean age 32 years (26–40) who are immersed for 14 consecutive days at a depth of between 8 and 10 m, pressure from 1.6 to 2 atmospheres, temperature 24–26 °C. Blood samples were taken at time 0 (30 days before the dive), the 1st, 4th and 9th day of immersion, and finally on the 15th and 24th day after returning to the surface.

Results In this period of observation, the blood levels of parathyroid hormone (PTH) and alkaline phosphatase (AP), while remaining within the physiological range, decreased during the dive, returning to baseline values after emergence. In contrast, vitamin D has increased during the dive and then return to baseline values after surfacing, constituting, as compared to PTH and AP, a inverse profile.

Discussion Only the study NEEMO V conducted by NASA has analyzed some bone markers, noting, however, diametrically opposite behaviours with respect to the blood concentration of vitamin D, while agreeing on the decrease in the concentration of parathyroid hormone. Both in NEEMO V as in our study there is a correlation between the parameters that describe the stress and variation of the data of the PTH and vitamin D, while being different duration and mode of immersion in the two studied groups.

Conclusions In the absence of gravity in underwater environment is possible to detect changes in PTH and AP correlated with stress. Although these values only preliminary, drawn from a study initially designed for cardiac and metabolic markers, it appears interesting variation of bone metabolites. These data represent a reference platform for the next study of the osteoporomalacia in divers, planned on a more prolonged immersion, where the qualitative analysis of bone metabolism, also will be joined with the quantitative evaluation.

The medical error corrected by online consulting: ethical problems and deontology

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Introduction In our previous study on medical counselling on the Web (SIOT Congress 2012) we reported, among other critical points, the online collection of serious medical errors made in the medical profession in real life. About medical error exists an extensive literature, but still nothing has been written about the possibility, unthinkable until recently, to gain knowledge on the internet for medical errors and to have the chance to fix them through a sophisticated online support action of user-patient relationship.

Methods We made an extensive literature review on the online consultation, trying to identify ethical and deontological issues that underlie this phenomenon. It was considered the website <http://www.medicitalia.it> (MI), the only website in Italy and one of the very few in the world that delivers free consultations online-on time with an attendance figure of 324,298 users, 5,513 physicians, 381,015 requests and 645,203 consultations provided since 2000, 150,000 visitors/day and 1,216 articles published online. In January 2014, the MI website has reached 3.6 million unique users with over 11 million page views (ShinyStat data). Website provided with the HONcode certificate, as required by the WHO and by the Italian General Medical Council/FNOMCeO.

Results The study shows the enormous problem of medical error, which is recorded during the online consulting. It's not uncommon, unfortunately, on the MI website have news suffered by users of critical events in their lives as real patients, who can go from conduct ethically incorrect to real errors in diagnosis and/or treatment with serious repercussions *quoad functionem et quoad vitam*. HONcode prohibits to provide diagnosis, treatment or outcome via the internet, therefore, in cases of obvious error, the medical consultants of MI, after a long discussion on the ethical, have decided to keep a strict compliance with the decisions of doctors in real life suggesting, however, a second or third opinion until error correction.

Discussion There is no trace in the national/international professional standards for this type of online medical services and, therefore, in online consultations with increasing frequency the doctors are having to cope on their own situations, high uncertainty on the ethical and high-risk medical professional without legal protections.

Conclusions The medical error is a real possibility of every physician, an event in which the scientific societies, GMC and institutions work to limit the occurrence and consequences. Today we can control it, limit it and correct it by medical consulting online. It should, however, an adequate legislation.

studies included radiographs in all cases, computer tomography (CT) in 76 % of cases, magnetic resonance imaging (MRI) in 22 %, both CT and MRI in 2 %. In 59 cases we identified with talo-calcaneal coalition/synchondrosis (TCC), in 31 calcaneo-navicular coalition (CNC), in 2 feet both TCC and CNC. Twenty feet underwent conservative treatment by means of orthoses, 42 feet were manipulation under general anaesthesia and casting in a supinated position and 30 feet underwent surgical treatment (15 TCC, 14 CNC, 1 CNC + TCC).

Results Cases were clinically evaluated at a mean follow-up of 24 months. Among patients treated with manipulation and casting: 4 % of cases showed very good results (complete motility and no pain), 46 % had good or fair results (pain or reduced of motility or mild flat foot), 12 % had poor results (pain and stiffness). As regards surgical treatment, among feet with TCC results were excellent in 51 % of cases, good or fair in 35 %, poor in 14 % of cases. Among feet with CNC result were excellent in 57 % cases, good or fair in 38 % and poor in 5 % cases.

Discussion Tarsal coalition is uncommon but insidious affection (1 %), sometimes requiring surgical treatment due to the pain related to it. A correct clinical diagnosis and instrumental assessment are needed to confirm tarsal coalition and surgeon should be aware of this condition, since in these cases the classical treatment performed for flat foot would lead to very poor results. Surgical indication for synosto-coalition removal and associated procedures (interpositional arthroplasty and correction of calcaneal valgus), should be carefully chosen (selected) depending on the location, the features and extension of the coalition and age of the patients, to ensure reduction of recurrences rate.

Conclusions When the conservative/orthotic treatment is not effective, surgical treatment of tarsal coalitions can lead to good results in terms of pain and functional outcome; best results are experienced in calcaneo-navicular coalition.

Posterior approach to the elbow to treat type III supracondylar humerus fractures in children: a case series on 30 patients

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Introduction The aim of the present study is to assess the medium-term functional results of 30 children treated with a posterior approach for a Gartland type III supracondylar humerus fracture.

Methods From 2006 to 2011, thirty children were surgically treated for a Gartland type III supracondylar humerus fracture through a posterior approach. All patients were evaluated with three elbow function scores: QuickDASH, Mayo Elbow Performance Index (MEPI), and the Broberg and Morrey rating system. Mean follow-up was 38 months.

Results Seventy percent (70 %) of patients achieved the maximum score on the QuickDASH. The mean score was 2.49/100, with 100 representing maximum disability. In 93.3 % of patients, the MEPI score was excellent, while 6.6 % of patients reported a good score. The Broberg and Morrey score revealed a top score of 100 in 60 % of patients, while 23.3 % of patients had a score of 90 or above.

Discussion Open reduction of supracondylar fractures must be reserved in cases of associated neurovascular lesions, open fractures, forearm compartment syndrome, or in cases of soft tissue interposition preventing the reduction of the fracture. The open reduction of the fracture may also be considered if enough time has elapsed from the trauma (the swelling of the soft tissues may prevent fracture reduction and alter the perception of the bony references when pursuing closed reduction and pinning), or in cases of failed percutaneous

PAEDIATRICS ORTHOPAEDICS

Tarsal coalition: surgical treatment

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Introduction The aim of this study was to report the experience of the department of Paediatric Orthopaedics and Traumatology of the Rizzoli Orthopaedic Institute in the surgical treatment of tarsal coalition in children.

Methods Ninety-two feet (38 unilateral, 27 bilateral, for a total of 92 feet studied) in 65 patients, surgically treated between 2006 and 2011 (42 boys, 23 girls, mean age 12 years) were reviewed. Imaging

fixation. The advantages of an open posterior technique include: safe surgical approach, precise fixation, exploration of injured muscles, vessels and nerves, and less X-ray exposure. The disadvantages include: increased surgical time compared to percutaneous pinning, ulnar nerve isolation, surgical scar, peri-osteal stripping, increased risk of physis injury or avascular necrosis of the lateral condyle, increased risk of post-operative elbow stiffness, and increased biological damage to the posterior peri-osteal hinge. Furthermore, there is controversy whether the surgical approach may weaken the triceps tendon resulting in elbow extension strength loss. The patients included in this study were only affected by type III supracondylar fractures treated with the same surgical approach. Also, we tried to assess the elbow as a functional entity. Many fractures were treated after much time from the trauma, and two patients had already been treated at another hospital.

Conclusions The posterior approach to the elbow to treat supracondylar humerus fractures represents a reliable surgical technique. It is associated with excellent functional results in terms of range of motion, stability, strength and pain.

Adequacy of treatment, bone remodeling, and clinical outcome in pediatric supracondylar humeral fractures

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Introduction The extension type supracondylar humeral fracture accounts for approximately two-third of all paediatric hospitalizations due to elbow trauma. Gartland classification leads the standard of care for this type of fractures. The present study evaluates and compares clinically and roentgenographically 62 extension type supracondylar fractures on the basis of the synthesis method and the severity of the fracture, with a mean follow up of 4 years and 3 months following treatment.

Methods We divided our sample in three main groups according to Gartland classification of supracondylar fractures and, successively, groups of Gartland type II and Gartland type III fractures were divided into subgroups according to the synthesis method (cast immobilization vs. two laterally inserted Kirschner wires for Gartland II and two vs. three laterally inserted Kirschner wires for Gartland III). Range of motion, elbow's axial alignment, muscle strength and joint stability were estimated. MAYO Elbow Performance Index (MEPI) and the POSNA-PODCI questionnaire were used. Radiographic measurements (Baumann's angle, humero-capitellar angle) were performed.

Results According to the Flynn criteria, MEPI, and POSNA questionnaire, all patients obtained satisfactory results with only slight differences among groups. According to the univariate logistic regression analysis in Gartland II supracondylar fractures, the stabilization of fracture's fragment with Kirschner wires is associated with a better functional and anatomical outcome. The univariate logistic regression analysis showed for Gartland type III supracondylar fractures that the use of a third Kirschner wire does not lead to a better result. Radiographic measurements showed that remodelling was wider in the sagittal plane than in the frontal one in the three types of fracture.

Discussion According to the Flynn criteria, the clinical outcome of our 62 patients was satisfactory, 65 % were rated excellent, and 35 % were rated good. Therefore, taking into consideration the case studies, the use of the Gartland classification system for the treatment of paediatric supracondylar humeral fractures is adequate.

Conclusions To conclude, our series demonstrated that the best way to approach type II supracondylar paediatric humeral fractures in terms of satisfactory outcome was by closed reduction and

percutaneous pinning, rather than by closed reduction without pinning. With regard to the Gartland type III supracondylar fractures, we did not find significant differences in the clinical outcomes because of the use of two or three wires. Moreover it was proved the validity of postoperative Baumann's angle as predictor of final carrying angle. Important results were achieved in our study on the physeal remodelling, it seems to have a positively influence on anatomical and functional outcome. Finally, it is important to pay more attention to the adequacy of reduction in frontal plane (BA's value) than in the sagittal one, for which a greater capacity of remodelling was proved.

Mini-invasive technique for Achilles tendon lengthening surgery in children with cerebral palsy. Evaluation of the results with gait analysis

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Introduction The most common spastic deformity in cerebral palsy is equinus, which involves contracture of the gastrocnemius or the gastrocnemius-soleus muscle tendon complex associate to less strength of the ankle's dorsiflexor muscle. In literature several different surgical techniques are described for lengthening of the Achilles tendon, but no one of these can be considered the best since the high percentage of failures reported. Failures consisting in talus deformity of feet with crouch gait due to gastrocnemius-soleus weakening or to recurrence of the same pathology.

Methods The authors report their experience referred to 250 patients affected by equinus in cerebral palsy; 135 feet were treated by unilateral lengthening of Achilles tendon, 115 by bilateral lengthening, as a whole 365 feet. Mean age at surgery was 8 years and 2 months. The authors used the Strayer modified mini-invasive surgical technique, consisting in a 2-cm longitudinal midline incision in correspondence of gastrocnemius-soleus aponeurosis, doing only a transverse gastrocnemius tenotomy. Otherwise from Strayer technique we did not make the so called "gastrocnemius recession" to avoid an higher gastrocnemius weakness.

Results All the patients were filmed with video and submitted both to pre-operative and post-operative gait analysis study. Post-operative gait analysis at three-month follow-up has demonstrated an early restored dorsiflexion and appearance of the ankle joint's strength. Instead at one-year follow-up gait analysis has shown a curve of foot dorsiflexion similar to the one's of normal population and a satisfactory strength of the ankle joint though significantly lower than normal population.

Discussion After lengthening of gastrocnemius fascia a significant improvement in ankle joint kinematics (in particular an improved prepositioning of the foot for the IC) was noted just at 6 months post-operatively. Besides this an increases in ankle joint peak power and in Wgen was noted. As to the ankle joint power and Wgen the push off ability is related it is possible to conclude that after the surgery children are able to walk with an increased push off ability. The reasons for this improvement may be that the muscle has been lengthened, thus delaying the stretch and reflexive response until late stance when push-off occurs. Then the muscle may be in a better mechanical position relative to the ankle joint to generate energy. Therefore we conclude that gait analysis data demonstrated positive results from the modified version of the Strayer lengthening. These results are consistent with those reported in the literature concerning the gastrocnemius fascia lengthening.

Conclusions The Strayer-modified surgical technique provides many advantages such as a lower percentage of recurrence, absence of over-lengthening, growing of muscle strength. This is a mini-invasive reliable technique that provides good clinical results observable in each step of our follow-up.

Outcome of displaced fractures of the distal metaphyseal-diaphyseal junction of the humerus in children treated with elastic stable intramedullary nails

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Introduction In skeletally immature patients, fractures occurring at the distal humeral metaphyseal-diaphyseal junction, just proximal to the olecranon fossa, are rare. Surgical management of such injuries traditionally consisted of closed or open reduction and internal fixation with Kirschner wires. In recent years, elastic stable intramedullary nailing (ESIN) has been suggested as the treatment of choice for this fractures, resulting in stable reduction and good rotational control. The main objective of this study is to evaluate the clinical and radiographic outcomes of displaced fractures of displaced the distal humeral metaphyseal-diaphyseal junction fractures in children treated by ESIN.

Methods From January 2011 to December 2012, 14 children with fractures of the distal humeral metaphyseal-diaphyseal junction were surgically treated by ESIN in three different institutions (one each Turin, Clermont-Ferrand and Bellinzona). Only patients with humeral fractures of the distal metaphyseal-diaphyseal junction according to Fayssoux's definition were included. All patients were treated according to the surgical technique described by Métaizeau. One year after the index surgery, patients were asked to answer the short version of the Disabilities of the Arm, Shoulder and Hand Outcome Questionnaire (Quick DASH).

Results Fourteen patients met the inclusion criteria. The average patient age at the time of injury was 9.7 years (range 3.6–13.7). Seven fractures were classified as transverse, 6 oblique and 1 comminuted. Each of the 14 fractures reduced by closed manipulation and stabilized using two titanium elastic nails of the same diameter. Fracture healing was achieved after 6–12 months. All patients returned to their previous daily and sport activities without discomfort or difficulty and they were free of pain at their last follow-up visits. The mean Quick DASH score was 0.81 (range 0–6.8).

Discussion According to our results, the treatment with ESIN of displaced distal humeral metaphyseal-diaphyseal fractures results in good clinical, radiological and functional outcomes. This is the first report about ESIN of this kind of fracture. This method provides good rotational control, but cannot completely prevent flexion or extension of the distal fragment. Residual transverse plane malalignment of the distal fragment in flexion or extension will not cause any major functional limitation, and it will eventually remodel during growth.

Conclusions ESIN, leading to stable reduction, good rotational control and a faster mobilization, is indicated in displaced distal humeral metaphyseal-diaphyseal junction fractures. Furthermore, surgical treatment is indicated in high-energy trauma with elevated risk of compartment syndrome.

FOOT AND ANKLE

Early results with 3D printed calcaneal fractures for evaluation of injury severity and surgical planning

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Introduction Currently, 2D and 3D computed tomography (CT) is mandatory to evaluate calcaneal fractures. However, recent studies demonstrated that the joint surface involvement cannot always be adequately assessed because of the presence of overlapping fragments or neighbouring bones. Three-dimensional printing is a new technology that uses a 3D computer representation to create solid objects. Early results with 3D printed models of calcaneal fractures are reported.

Methods Between October 2013 and March 2014, 8 calcaneal fractures (Sanders type III and IV) were investigated preoperatively with CT scan. Editing the 3D reconstruction, the calcaneal bone was isolated with digital scissor tool. The file was exported and prepared for printing with a dedicated software. A commercial 3D printer was used to manufacture a 1:1 model, white colour, with high resolution of details, which was available only 10 h after CT scan. Finally, the printed calcaneus was handled prior by the surgeons and later by the patient to be studied and examined in order to plan and clarify the operative treatment.

Results The model was assessed before surgery by expert foot surgeons and residents. Both experienced an incredible improvement of understanding fracture's patterns compared with the analysis of the 2D and 3D reconstruction on PC-screens. Useful details as joint fragmentation, yielding and dislocation of the talar surface were appreciated in an extremely realistic way, allowing a high quality simulation of the operative planning. The calcaneus was showed to the patient, drastically increasing his education and refining the surgical informed consent.

Discussion Although 2D and 3D CT imaging provides a satisfactory assessment of calcaneal fractures, the damage of the articular surface may not be completely estimated. Three-dimensional printing, with the ability to create solid objects, may be helpful to improve understanding of anatomy and pathology by means of tactile and visual experience to integrate images displayed on a computer monitor. Consequently, an accurate simulation of the operative treatment and an easier patient education can be achieved before surgery.

Conclusions In this preliminary study, 3D printed prototypes proved to be valid and effective tools to offer an improved sense of spatial pathology of calcaneal fractures.

Charcot neuroarthropathy: involvement of oxidative-induced epitopes of collagen type II in its pathogenesis

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Introduction Charcot neuroarthropathy is a disabling complication of diabetes; its etiopathogenesis is still unknown. The disease is characterised by varying degrees of bone and joint disorders with an

underlying neuropathy, trauma and perturbations of bone metabolism. It has been proposed that the genetic regulation of bone remodelling is associated with Charcot neuroarthropathy. However, diabetic neuropathy alone cannot completely explain the onset of Charcot neuroarthropathy. The aim of the study was to investigate on the role of autoimmunity in presence of collagenic post-translational modifications related to oxidative stresses.

Methods ELISA was used to establish a potential relationship between Charcot neuroarthropathy (and related neuropathies) and oxidative modifications of collagen type I and II. Sera from patients with diabetic neuropathy (DN) with and without Charcot disease (Ch) and healthy (H) controls were tested for the presence of autoantibodies against native collagen type I and II (CI and CII), and post-translationally modified CI and CII, using reactive oxygen species (ROS).

Results Autoantibodies to native and ROS modified collagen type I (ROS-CI) and ROS-CII have been detected in patients with Charcot disease and diabetic neuropathy, but not in healthy controls.

Discussion Patients affected by Charcot neuroarthropathy reveal to have autoantibodies against CI and CII due to oxidative stress. Oxidative stress is increased in case of inflammatory or metabolic disorders and lead to a dis-regulation of immunity balance, especially towards CII which is the main component of joint cartilage.

Conclusions We propose that autoimmune reactions to native and post-translationally modified self antigens may play a role in the pathogenesis of Charcot and related neuropathies.

Spectrum and antibiotic sensitivity of germs isolated in patients with infection of diabetic foot ulcers

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Introduction Infections are the leading cause of hospitalization in patients with diabetic foot ulcers. Therefore, in order to appoint the most appropriate antibiotic treatment, is essential to locate the bacteriology. The purpose of this study was to identify the bacterial populations and to assess the strength and sensitivity of isolated pathogens to antibiotics.

Methods We examined 765 samples taken from infected ulcers, to assess the microbial population. It was also verified in vitro sensitivity and resistance towards different classes of antibiotics.

Results We isolated 1251 microorganisms and 69 different microbial species. The Gram-positive bacteria were identified in the 52.6 % of samples. Among them, staphylococci were the most frequently isolated species (31.5 %), with higher prevalence of *S. aureus* (26.8 %) and *S. coagulase-negative*. Enterococci were isolated in the 16.9 %. Streptococci were isolated in the 4.2 %. The Gram-negative bacteria were isolated in the 41.5 % of samples. Among them, *Pseudomonas aeruginosa* was identified in the 13.1 %, *E. coli* in the 6.8 %, *P. mirabilis* in the 5.2 %, *Acinetobacter baumannii* in 3.5 %, *K. pneumoniae* in 3.3 %. Anaerobic pathogens were isolated in the 5.9 % of samples, with higher prevalence of *B. fragilis* (3.9 %). The cultures were also distinct in monomicrobial (57.2 %) and polymicrobial (47.3 %). In polymicrobial samples the main associations identified were *S. aureus* and *Pseudomonas aeruginosa* (7.4 %), *S. aureus* and *Ent. faecalis* D (6.2 %), *P. aeruginosa* and *Ent. faecalis* D (6.1 %). With regard to the resistance to antibiotics, staphylococci have shown resistance to amoxicillin/clavulanic acid in 66 % of cases, 62 % to ciprofloxacin, erythromycin in 56.9 % and gentamicin in 51.8 %. Enterococci showed resistance to erythromycin in 66.7 % of cases, in 25 % imipenem, ampicillin in 17.5 %, 4.5 % in the vancomycin and

teicoplanin in 4.2 %. Streptococci showed resistance to erythromycin in 32.4 % and 31.3 % to the gentamicin. None of the 3 classes showed resistance to linezolid. The Gram-negative bacteria showed resistance to cefotaxime in 60.7 % of cases, in 57.5 % to ciprofloxacin, amoxicillin/clavulanic acid in 55 % and gentamicin in 54.4 %.

Discussion The study found that 6 microbial species are responsible for about 70 % of infections. The most common pathogens, *S. aureus* and *S. coagulase-negative* pathogens account for 31.5 % of infections. We have identified a very high percentage of MRSA (59.4 %). The Carbapenems are the chosen drugs in infections with Gram-negative bacteria. The most current multidrug-resistant microbial agents were *P. aeruginosa* (in 3.6 % of samples) and *A. baumannii* (in 25 % of samples).

Conclusions The initial antibiotic coverage should always include *S. aureus*, the more frequent infectious agent, and Gram-negative bacteria, often associated with severe infections.

Preliminary results of a new ankle prosthesis implanted with a lateral surgical approach

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Introduction Total ankle replacement (TAR) goals include relieving pain and restoring the ankle motion, allowing normal daily activities. Nowadays there are many kinds of ankle prosthetic models available: despite that, the results obtained are still not completely satisfactory in terms of pain reduction and functional outcomes. The only ankle prosthetic model currently on the market, which seems to respect both the ankle joint biomechanics and anatomy, consists of only two components and is implanted through a lateral surgical approach.

Methods The indications for TAR, by our clinical experience, included: primary and post-traumatic osteoarthritis in patients over 50 years old or younger patients with low functional demands, rheumatoid arthritis with reduced functional compensation for other joints involvement, osteoarthritis in patients with less than 20° of flexion–extension in the other foot joints and patients who refuse an arthrodesis procedures. Thirteen patients were treated with a new ankle prosthetic model (Zimmer TM) characterized by an anatomic design and implanted through a lateral trans-malleolar approach. Patients mean age was 62.9. Patients were clinically and radiographically evaluated using the AOFAS score and through standard and weight-bearing radiographs at a 7 months mean follow-up.

Results Clinical evaluation showed an increase in the AOFAS score, from a mean of 62 pre-operatively to a mean of 89 at the last follow-up. No complications were observed. In one case a lateral wound dehiscence occurred and the fibular plate was removed. Radiographic analysis showed no delay in the osteotomy consolidation or implant loosening.

Discussion The Zimmer TAR system consists of two implant components, a talar component and a tibial base component attached to a modular tibial articular surface; the implant trabecular metal coating contributes to provide initial stability and rapid bone in-growth and the lateral approach allows to perform a wide ankle release to better improve the range of motion. Despite that the procedure requires a significant increase in surgical time, if compared to other TAR prosthetic models, no intra-operative or post-operative complications occurred. Results were very satisfactory both from a clinical and imaging point of view.

Conclusions Patients treated with the new ankle prosthesis achieved excellent clinical outcomes and preliminary results are very satisfactory; despite that, a longer follow-up is necessary to evaluate the behaviour of the implant over time.

Bone marrow-derived cells and biophysical stimulation for talar osteochondral lesions: a randomized controlled study

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Introduction Osteochondral lesions of the talus (OLT) frequently occur after ankle sprains in young patients participating in sports activities. These injuries may lead to chronic pain and finally osteoarthritis; therefore, surgical repair is frequently needed. A collagen scaffold seeded with bone marrow-derived cells (BMDCs) harvested from patient's iliac crest and implanted into the OLT through a single arthroscopic procedure has been recently proposed as an effective treatment option. Nevertheless, BMDCs, embedded in an inflammatory environment, tend to differentiate toward a fibroblast phenotype with a consequential loss of mechanical characteristics. Biophysical stimulation with pulsed electromagnetic fields (PEMFs) has been shown to promote anabolic chondrocyte activity, stimulate proteoglycan synthesis, and reduce the release of the most relevant pro-inflammatory cytokines. The aim of this randomized controlled trial was to evaluate the effects of PEMFs on clinical outcome in patients who underwent BMDCs transplantation for OLT.

Methods Thirty patients affected by grade III and IV Outerbridge OLT underwent BMDCs transplantation. After surgery, patients were randomly assigned to either experimental group (PEMFs 4 h per day for 60 days starting within 3 days after operation) or control group. Clinical outcome was evaluated with American Orthopaedic Foot and Ankle Society (AOFAS) score, Visual Analog Scale (VAS), and Short Form-36 (SF-36).

Results In both groups significantly higher AOFAS score was recorded at 12 months follow-up compared to baseline (94.3 ± 7 vs. 54.1 ± 20.1 in the experimental group $p < 0.0001$ and 81.0 ± 20.2 vs. 48.9 ± 23.0 $p = 0.002$). A significantly higher AOFAS score was recorded in the experimental group compared to controls at 6 and 12 months ($p = 0.035$ and $p = 0.014$, respectively). At 60 days and 6 and 12 months follow-up, significant lower pain was observed in the experimental group ($p = 0.039$, $p = 0.024$ and $p = 0.04$, respectively).

Discussion PEMFs protect transplanted cells from catabolic action of proinflammatory cytokines and stimulate the anabolic action of both transplanted cells and adjacent cartilage. Biophysical stimulation after regenerative surgery improves clinical results especially in young patients with elevated functional demand.

Conclusions Biophysical stimulation started soon after surgery aided patient recovery leading to pain control and a better clinical outcome with these improvements lasting more than 1 year after surgery.

Total ankle replacement and grade deformity: the role of learning curve in a consecutive series of 60 cases

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Introduction Post-traumatic arthritis, peritalar instability, ankle and hind foot deformity are the most common causes of ankle arthritis in patient without systemic diseases (i.e. rheumatoid arthritis). Historically, deformity was considered a TAR contraindication. This is the reason why even today, most of the patients with post-traumatic ankle arthrosis often undergo to arthrodesis. The prosthetic ankle, on the contrary, has only earned popularity recently, thanks to the third

generation ankle prostheses. Unfortunately, the major part of medicine literature was written by surgeons involved in the ankle prosthesis planning. This represents an important bias and makes more difficult to define the real learning curve. Another limit is to define the learning curve in case of arthritis with important deformity. **Methods** We collected retrospectively clinical dates (AOFAS score, VAS) and radiographic (weight bearing X-ray + Saltzman 20°) from 60 consecutive patients, who presented post-traumatic ankle arthritis, underwent to Hintegra mobile-bearing ankle prosthesis (average follow-up: 2 years). The average age of the patients was 58 years (22–57), 35 male, 25 female. 40 patients had undergone to a simple ankle prosthesis (one step surgery), 13 patients had been performed almost one associated osteotomy (foot or/and ankle), 10 associated arthrodesis (9 subtalar joint fusion, 1 double fusion: talo-navicular fusion + subtalar joint fusion), 11 elongation of Achilles tendon (percutaneous).

Results We haven't planned any implant revisions yet. All the patients are still in the follow-up program. We had 5 difficult wound healings, in 2 cases plastic intervention was needed (1 flap, 1 tenotomy of the posterior tibial tendon according to Kofoed with a new suturing). Both wounds healed. We registered 8 intra-operative fractures: 5 tibial malleolar fractures, 2 fibula fractures, 1 of the posterior body of the talus: 7 out of 8 occurred in the first 10 cases. All the fractures healed in the post operative time. A patient (treated with a double fusion in another hospital 30 years before) was planned to be operated on ankle prosthesis + malleolar osteotomy (tibia land fibular), that granted a stable, mobile and plantigrade ankle. After 1 year from the first intervention, the patient underwent to rotational osteotomy of the talus because minifoot correction was needed to be performed. During the healing period the major complication was a deep infection, that required a long antibiotic therapy (suspended due to Stevens Johnson reaction subsequently restarted in association with cortisone), local VAC Therapy, 2 steps cover intervention (plastic surgery) without removing the implant. Two years after the surgery the patient can walk without pain. The average surgery time was 130 min for the first cases, while the total average is about 100 min. **Discussion** The follow-up showed, may not be long enough to identify the possible cause of failures at medium-long term. Moreover, isn't possible to identify functionality differences between operated patient at the beginning and at the end of the learning curve. However we saw a major rate of complications during the intervention. The surgery time was longer in the group of the first 10 treated patients.

Conclusions TAR is a reliable therapeutic option for the treatment of post-traumatic ankle arthritis. The post-traumatic deformity isn't considered an absolute contraindication to the ankle prosthesis. At the end a rigorous planning with standard weight bearing X-ray of foot and ankle + Saltzman 20°, is necessary, especially in some cases in which additional procedures are provided, but also in some seemingly simple cases that could be treated with isolated procedures, such as ankle prosthesis.

SPINE

Impending fracture of the metastatic lumbar spine: a finite element model to study the risk of fracture and the role of prophylactic vertebroplasty

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Introduction The vertebral column is one of the most frequent site of metastatic involvement of the skeleton. Vertebral fracture can cause

relevant neurological complications. Vertebroplasty can prevent neurologic impairment if performed at an early stage. The aim of this study was to develop a finite element model of the metastatically involved lumbar spine to biomechanically assess vertebral stability and provide clinicians important information to evaluate the risk of fracture in patients with lytic metastases. Moreover, we analysed the effects of vertebroplasty on the strength of the vertebral body and the risk of adjacent vertebrae fractures in order to evaluate the feasibility of the procedures to achieve prophylactic stabilization.

Methods A FE model of the lumbar spine (L3–L5) was created from the CT-scan of a human cadaveric spine specimen (male, age 52). The tumour was modelled by selecting a core of elements of L4 vertebral body and giving it the material properties of a metastatic tissue (Elastic Modulus 0.01 MPa, Poisson's ratio 0.4995). The vertebroplasty (PMMA) was created in a similar way (elastic modulus 3,000 MPa, Poisson's ratio 0.41). Parametric analyses were performed varying tumour size, cement volume (15 and 30 % of the vertebral body volume) and bone mineral density. A compressive load, flexion and extension were simulated. Vertebral bulge (VB) and axial displacement (VH) were used to assess the risk of failure of the metastatic vertebra. The Von Mises stress was analysed to assess the influence of cement augmentation on load transfer in adjacent vertebrae.

Results The presence of a metastatic lesion in the vertebral body increases both VB and VH. Tumour size and bone mineral density affect the entity of the increment. Vertebroplasty increases vertebral stability: it reduces both VB and VH in all scenarios analysed. Cement augmentation affects the Von Mises stress in the adjacent vertebrae. The volume of cement slightly affects the Von Mises stress, instead the bone density has a greater impact on the results.

Discussion The metastatic lumbar spine has an increased risk of fracture that is correlated with tumour size and bone mineral density. Vertebroplasty provides biomechanical stability to the vertebral body preventing neurologic impairment if performed at an early stage. However, it facilitates adjacent vertebral fracture, especially in those patients with spine metastases affected by osteoporosis.

Conclusions Further studies are needed to identify objective criteria to estimate the risk of vertebral impending fracture and to select patients that most can benefit from prophylactic vertebroplasty.

Role of endothelial dysfunction as a risk factor for lumbar disc degeneration

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Introduction Lumbar disc degeneration (LDD), a condition whose incidence increases with aging, can often be either asymptomatic or show no signs at imaging. A possible causal factor of LDD may be the reduction in nutrient supply to the intervertebral disc (ID) due to an impaired microvascular response to mechanical stresses borne by the lumbar spine. We tested the hypothesis that a defective vasodilator response of microcirculation is related to advanced LDD.

Methods Considering impaired vasodilation in response to mechanical loading as a systemic condition, post-ischemic vasodilation has been measured at the brachial artery through a Doppler ultrasound test in 60 caucasian patients (mean age 55 ± 4) showing signs of LDD on magnetic resonance imaging classified according to Pfirrmann grading system. Patients with diabetes, hypertension, chronic

inflammatory states, autoimmune arthritis, listesis, trauma to the spine and previous surgeries were excluded from the study. The Modified Oswestry Low Back Pain Disability Questionnaire (MODQ) was used to collect clinical data regarding the patients. A statistical analysis was performed to correlate the results of the US assessments, the severity of LDD and the level of disability for low back pain in the patients.

Results Patients were classified into 5 groups according to their Pfirrmann grading assessment. We have found that evidence of a more severe LDD has an inverse correlation with the values of mean brachial artery diameter as measured after an ischemic stimulus ($p < 0.0001$). Also, the values resulting from MODQs showed statistically significant intergroup differences ($p < 0.005$).

Discussion ID is an avascular structure which receives nutrients and dispose waste products through a process of osmotic diffusion to the nearby capillary network. The process is supported by the changes in blood pressure induced by spine movements but it requires an effective response of microcirculation to mechanical stress.

Conclusions We support the idea that an imbalance between vasodilator and vasoconstrictor substances may be the cause of the reduced post-ischemic vasodilation we found in patients suffering from LDD. Data presented lay the groundwork to deeply investigate vascular features as predisposal factors for the beginning and progression of LDD with future studies needed to further understand this pathologic mechanism.

Complications in spinal surgery: knowing to prevent. Analysis of 917 cases treated in 3 years

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Introduction The surgical treatment of complex spinal deformity and vertebral oncological diseases is becoming more common. The aim of this study was to prospectively record all the major complications observed in the peri-operative and post-operative period for surgeries performed at our Division of Spine Surgery in the 2010–2012 period, correlating this score with different parameters in order to determine possible risk factors.

Methods Two hundreds and eighty-five surgeries were registered in 2010, 324 in 2011 and 308 in 2012. All the complications observed during the procedure and the follow-up period were recorded and classified according to the type (mechanical complications, neurological complications, infection, hematoma, cerebrospinal fluid fistula, systemic complications, death related to the surgery).

Results In 2010, on 285 surgeries 47 patients (16.5 %) had 69 complications (24.2 %): 25.7 % for the treatment of oncological diseases, 23 % for the treatment of degenerative diseases, 27 % for the treatment of pathologies of traumatic origin, 11 % for the treatment of spondylodiscitis (infectious diseases). In 2011, on 324 surgeries 35 patients (10.8 %) had 54 complications (16.7 %): 16.3 % for the treatment of oncological diseases, 16.3 % for the treatment of degenerative diseases, 20 % for the treatment of pathologies of traumatic origin, 28.6 % for the treatment of spondylodiscitis. In 2012, on 308 surgeries, 25 patients (8.1 %) had 36 complications (11.7 %): 14.4 % for the treatment of oncological diseases, 7.2 % for the treatment of degenerative diseases, 16.7 % for the treatment of pathologies of traumatic origin, 20 % for the treatment of spondylodiscitis.

Discussion On 917 spinal surgeries performed from January 2010 to December 2012, 159 complications (17.3 %) were recorded, with a prevalence of mechanical complications and infections.

Conclusions The correlation of these complications with different parameters, such as age, sex, presence of co-morbidities, previous spine surgery, type of surgery, will be analyzed in order to detect potential risk factors to be taken into consideration in the decision-making process for complex spinal surgery.

Development of a risk scoring system to define the risk of osteoporotic vertebral compression fracture in post-menopausal women

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Introduction Osteoporosis affects 200 million people worldwide and is responsible for about 1.5 million vertebral fragility fractures (VCFs) a year. The majority of patients are unaware of their osteoporosis and seek medical attention only after developing a VCF. DEXA is commonly used to measure bone density but it imperfectly measures the fracture risk. The objective of this study is to develop a scoring system to assess the risk of developing a first osteoporotic VCF in post-menopausal women.

Methods We conducted a retrospective cross-sectional analysis on 477 post-menopausal women. Included in this study were patients who either had no VCFs or a single prior VCF. Fifteen different clinical variables were analysed: age, body mass index, weight, L1–L4 and femoral neck T-score, L1–L4 and femoral neck Z-score, L1–L4 and femoral neck BMD, smoking habit, alcohol use, 25-OH Vit D, total alkaline phosphatase, bone alkaline phosphatase, and L4 vertebral volume. The patients were randomized into either a derivation or a validation cohort. A regression model was used to develop a predictive score for VCF in the derivation cohort; the performance of this model was tested in the validation cohort.

Results A total of 242 patients (mean age 69.1) were enrolled in the derivation cohort and 235 patients (mean age 68.7) in the validation one. A total of 205 patients had a VCF at the enrolment. Age (OR 4:47, $p < 0.001$), L1–L4 T-score (OR 2.64, $p < 0.001$), femoral T-score (OR 1.94, $p < 0.008$), L4 volume (OR 3:06 $p < 0.005$), and smoking habits (OR 2.85, $p < 0.007$) were found independent risk factors for VCF in a multivariate analysis of the derivation cohort.

Discussion On the basis of the relative strength of its regression coefficient, each variable is assigned a score from 0 to +12. From this, a risk scoring system from 7 to 39 points was derived. We found that 22 points is the best cut-off to select patients at an increased risk of fracture.

Conclusions A score derived by historical and routine blood-chemistry can be used to measure the risk of developing VCFs. Patients with high scores should be assigned to more stringent follow-up programs. In addition, assessment of risk may increase treatment compliance.

Conservative treatment in adolescent idiopathic scoliosis with curves over 45°: is the measurement in Cobb degrees the only parameter to be considered?

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Introduction The recent literature showed positive results in bracing patients with idiopathic scoliosis above 45° that refused surgery. However, no one has investigated whether other parameters are able to affect the results. The aim of this study was to evaluate the effectiveness of the brace in idiopathic scoliosis with curves above 45° and to assess whether the magnitude of the curve in Cobb degrees is the only parameter for the indication to surgical or conservative treatment.

Methods This is a prospective study based on ongoing database including 1,238 patients with idiopathic scoliosis. The study including idiopathic scoliosis with 45° or more, Risser 0–4, who had utterly deny any surgical intervention. Fulfil the inclusion criteria 160 patients. Of these, 104 patients has definite outcome, 28 abandoned treatment and 28 are currently under treatment. The minimum duration of follow-up was 24 months. X-rays was used to obtain Cobb degrees and torsion of the apical vertebra (Perdriolle's method). Three outcomes were distinguished in agreement with SRS criteria: curve correction, curve stabilization and curve progression. We have divided the sample in subgroup according to Risser (0–2; 3–4), to rotation (<20; >25) and to type of curve. The Kruskal–Wallis and Spearman Rank Correlation tests have been used as statistical tests.

Results The results from our study showed that the 104 patients with a definite outcome Cobb mean value was 47 ± 5.37 SD at beginning and 34.18 ± 8.45 SD at follow-up. Perdriolle was 20.2 ± 5.49 SD at beginning and 16.76 ± 7.04 at follow-up. Curve correction was accomplished in 81 patients (77.8 %), whereas a curve stabilization was obtained in 15 patients (14.4 %), 9 patients (8.6 %) have a curve progression and 16 (15.4 %) where recommended for surgery. The subgroups with rotation <20 showed a correction/stabilization in 98.1 % and surgery referral in 1.8 % while in subgroups with rotation >25 a correction/stabilization was achieved in 69.4 % but surgery referral in 60.8 %. The subgroups with Risser 0–2 showed a correction/stabilization in 92.6 % and surgery referral in 10.3 % while in subgroups with Risser 3–4 a correction/stabilization was achieved in 91.6 % but surgery referral in 25 %.

Discussion Results allow to say that an adequate brace treatment must be absolutely considered in the treatment of scoliotic curves above 45° in patients who refuse surgery.

Conclusions Brace treatment should be considered as the first choice to try avoiding fusion if the rotation is lower than 20° and Risser is between 0–2.

ORAL COMMUNICATIONS

LOWER LIMBS DEFORMITIES 1

Diagnostic pitfalls of the “short leg”

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There are many factors determining differences in length (longitudinal heterometry, following heterometry) between the two lower limbs and all of them must be considered to understand if the difference is real or apparent. Each lower limb must be considered as a set of single segments (pelvis, thigh, shank and foot) and if this segments are perfectly aligned they have a length who is the sum of each single segment but if there are one or more angles between them the total length is shorter in function of the angles magnitude. It is clear, therefore, that a limb on the side where there is a flat or pronated foot (hence an arch lowering) and/or a varo-valgus or recurvatum knee (respectively femur and tibia angulation in the frontal or sagittal plane) will be shorter than the controlateral. On the contrary there is just one condition that causes a lower limb elongation: the varus foot; in this case, as known, the plantar arch is higher than normal.

In order to determine with certainty whether two lower limbs have actually different lengths it is mandatory to correct the unstructured pathologies (as knee recurvatum or foot pronation) and take into account those structured (knee varus or valgus, for example) and then correct the data. This allows you to determine if really there is an heterometry and its entity. But there is still another important pitfall: the pelvis. To diagnose an heterometry of the lower limbs we have as pelvis bone referrer points the iliac crest and the anterior and posterior-superior iliac spina (ASIS and PSIS); also here we must be extremely careful and evaluate all parameters because even the pelvis could have a false obliquity and then fool about the actual length of the lower limbs. A pelvis is oblique when it rotates in its entirely in relation to the frontal plane; in this case ASIS, PSIS and iliac crest will be higher or lower on the same side and therefore there is no doubt that the lower limb is longer or shorter, respectively. These data are to be added to what above in order to diagnose which of the two lower limbs is shorter or longer.

It is not at all uncommon, to find that the ASIS of one side is, for example, lower while the PSIS of the same side is higher. Here, do we have to consider the lower limb shorter or longer?

Why does it happen? Well, that happens when an hemipelvis rotates on the sagittal plane in relation to the other side hemipelvis or both, but in opposite direction; in this last case we have a real torsion of the whole pelvis. The iliac crests height, in this case, is not reliable because, being them rounded, the turning does not make change in their level. In these cases is very difficult to decide if there is an heterometry and only an accurate evaluation of all parameters and an adequate experience can help. A pelvis twist is easily detectable on an

X-ray to a quite experienced eye. On the contrary, on the basis of what previously written, we can never make a diagnosis of “short leg” through a standing X-ray examination of the whole lower limbs, even on squared sheet because lacks the “third dimension”.

Conclusions In conclusion, the diagnosis of lower limb real or fake heterometry is possible only if are available all these parameters and mostly the clinic ones.

Deformity correction of patients with vitamin D resistant rickets

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Introduction Hypophosphatemic rickets (also called vitamin-D resistant rickets) refers to a rare genetic form of rickets not sensible to vitamin D treatment and with low levels of phosphate in the blood that provokes an altered mineralization, reduced growth and lower limb multiplanar deformities. The target of this study is to get a revision of treated patients in order to evaluate benefits and complications.

Methods Thirteen patients have been treated since 2003, They were followed from early childhood to skeletal maturity. Twenty-six correction surgeries were done at lower limbs (6 femurs and 20 tibias) and they were all treated with external fixation with an age between 10 and 18 years old (the average age was 11 years old). All patients were in therapy with phosphate and vitamin D. The alignment of the limb was taken into consideration both clinically and radiographically by measuring the mechanical axis deviation and the knee orientation lines as described in Paley's et al. method.

Results All patients presented a minimum 2 months follow-up. After 1 month from the surgery, all the patients presented a good correction of the deformity. Forty percent (40 %) of them were treated again due to the recurring of the deformity. Three percent (3 %) of them fractured the femur after the removal of the external fixator. Traditionally, the pharmacological treatment of these patients consists of a supply of phosphate and vitamin D. The use of these drugs from early childhood shows a reduction of skeletal deformities. Surgery can help to reduce deformities and with the help of the pharmacological therapy can reduce active rickets but coexistent osteomalacia cannot heal. Consequently, deformities can recur even if a metabolic control and surgical treatment are carried out perfectly.

Discussion The lower limb deformity in vitamin-D resistant rickets, should be corrected in order to prevent early degeneration of the joint surface that can give rise to arthrosis.

Conclusions The use of external fixation allows the correction of deformities gradually in order to assure the best axial correction and healing of the treated limb. In any case, it's mandatory that patients, before doing any kind of surgery, should be well compensated from the metabolic point of view. The lengthening should not be more than four centimetres in order to guarantee a good healing in a correct period of time, which is longer in anyway than in normal conditions patients.

Possibility to correct deformity and functional disease in iliac dislocation Crowe 4 (osteotomy with shortening and repositioning into paleocotile)

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Introduction The aim of this study was the evaluation of the possibility to correct severe deformities and functional alterations induced by the iliac dislocation Crowe 4 with the technique of arthroplasty with shortening osteotomy and repositioning in paleocotile.

Methods Thirty-five cases were treated by a single surgeon with the technique of repositioning in paleocotile and femoral shortening osteotomy.

Results The authors report good and excellent results with good recovery on pain, asymmetry, body schema and walking.

Discussion and Conclusions The authors suggest indication for surgery in unilateral dislocation, absolutely if painful, relative in the case of purely functional disorder. For bilateral dislocation, the indication is to be evaluated very carefully, because it may be preferable to refrain from surgery. The surgery should be performed in overt clinical symptoms and rarely as a preventive measure. The recommended technique provides an accurate pre-operative planning, the placement of the acetabular prosthesis in paleocotile, after checks with TAC. By lowering the centre of rotation of the hip greater than 3–4 cm is indicated subtrochanteric femoral shortening osteotomy and the use of special stems.

Tibial osteotomy indications and results in lower limb torsional defects with patello-femoral disease

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Introduction In the pathogenesis of femoro-patellar anterior knee pain, the femoral and/or tibial torsional defects have a fundamental role in the surgical indication choice.

Methods We focused on the osteotomies where was practised an internal tibial rotation, isolated or associated with a closing wedge. We have not considered the opening wedge osteotomies, which correct only the varus deformity. We examined the effect produced by detorsion on the sagittal plane (*recurvatum*) and the tibial external rotation. In all the patients was respected the indication to avoid varus hyper-corrections and tibial torsions hypo-corrections.

Results We revised 15 of the 25 patients between 16 and 28 years old at the time of intervention that had surgery from 1997 to 2009, with the purpose to evaluate results about pain, aesthetic appearance, functionality and to find possible negative effects of detorsion. All the patients had pain remission that was full in 9 and incomplete in 6. In 10 of them, there was an increase in external tibial rotation and in 8 of them, in addition, a *recurvatum* with no functional consequences. Follow-up between 5 and 12 years, shows favourable results of the external tibial torsion surgical correction.

Discussion All femoral or tibial paramorphisms, isolated or combined, may give rise to a femoro-patellar disorder even if, for treatment purpose, it will not be always favourable to change those features. Between the possible torsional combinations which elicit patellar pain and characterize the different morphotypes, we

examined the osteotomies performed to treat the external tibial torsions. Clinically, they are distinguished by a more evident tibial varus at parallel feet. We did not ever perform the double derotational osteotomy, femoral and tibial, essential to treat the symmetric combined torsional deformities that we can find in high grade patellar strabismus.

Conclusions An opening tibial derotational osteotomy in presence of a conclamate tibial extratersion, where the concomitant internal femoral torsion is not particularly high, is a logic surgical option which allows favourable results regarding pain but it cannot optimize or normalize the limb morphology. Regarding the long recovery time, due to the bilateralism of deformity, this surgical indication must be reserved to patients with heavy functional defects and with negative prognosis because of the evolution of deformity and the consequence about the future joint condition.

Varus knee and patellar malalignment, surgical technique: tibial osteotomy, patellar transposition with external fixator

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Introduction Knee OA is often related to an abnormality of the lower limb torsion, that is expressed at the intermediate level with a varus at tibio-femoral joint and external patellar hyper-pressure epiphenomena. We proposed a correction by a proximal tibial valgisation osteotomy controlled by an external fixator, associating a patellar realignment.

Methods In over 20 years, since 1990, 1200 interventions were performed; mean age was 40 years, the ratio between females and males is 3:2, an average of varus of about 8°, an average time of removal of the fixator about 48 days, results in 550 patients were evaluated at a minimum of 1 year and a maximum of 12; evaluation criteria were VAS, ROM, X-ray, analysis of the clinical course.

Results The results were excellent in 39 %, with a recovery of normal function, good in 52 %, asymptomatic during routine activity and lightweight sports; unsatisfactory in 9 %. The failures are mostly connected to an inappropriate surgical indication, due to already established osteoarthritis; 2 % of complications have been given by osteolysis around the screws, iatrogenic fractures of the tibial plateau occurred in 1 %, loss of correction for early removal of the FE in 1.2 %, recurrence of the deformity for hypo-correction 2.3 %, over-correction in 3 %, infection rate 0.8 %.

Discussion In the treatment of the axial lower limb deformities, compared to the traditional techniques of osteotomy, external fixator gradual correction allows the maximum precision of the result, since it allows to adjust the segmental correction aspect not only based on usual radiographic static parameters, but more effectively by associating clinical dynamic evaluation of the limb, the fixator is controllable even during gait and available for further deferred adjustments.

Conclusions This technique ensures the mechanical effectiveness and results, is superior in accuracy compared to alternative techniques and not affecting any future reconstructive strategies, the associated patellar transposition permits to treat in one step all the deformity, it does not compromise results and avoids a second time intervention.

LOWER LIMBS DEFORMITIES 2

Femoral bony recurvatum: radiographical features and surgical indications for an unknown deformity

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Introduction Between deformities in bony *genu recurvatum*, the most popular is the tibial recurvatum. The femoral localization is less known and its clinical and radiographical finds are not well defined so they may be unrecognized if not acquainted.

Methods Between 36 *genu recurvatum* from Department of Knee Repairing Surgery of G. Pini in Milan, we found a femoral *recurvatum* only 4 times thanks to intracondylar angle measurement. This is a geometric parameter represented by intersection between femoral anatomical axis and the tangent to intercondylar notch or Blumensaat line. The mean value is 33° and this is higher in the femoral *recurvatum*, where we found angles between 45° and 58°. The gold standard surgical treatment for this kind of deformity is the femoral osteotomy.

Results The *procurvatum* femoral osteotomy, with posterior bony closing wedge, allows a restitution *ad integrum* with good functional results for *recurvatum* correction.

Discussion The femoral *recurvatum* results from a traumatic contusive or contusive-sprain accident in the childhood or adolescence. Immediately after the trauma the X-ray appears negative because there is a type V° Salter and Harris crush injury. The trauma will be identified only after several time when we can recognize at X-ray the distal epiphyseal line. Clinically it will be evident as an harmonic knee *recurvatum* which is different from a tibial *recurvatum* that is disharmonic and has a similar pathogenetic mechanism. The femoral *recurvatum* is more frequent and has typical clinical and radiographical characteristics. Clinically, is difficult to differ from a capsulo-ligamentous *recurvatum* and it will be underestimated at X-ray if its features are not well known. At clinical examination, they are represented by a normal knee morphology and subjective instability without articular laxity. At X-ray there are no atypical signs in antero-posterior view but in the lateral view we can recognize the femoral condyles flattening, in particular the lateral, and especially, the identification of the intracondylar femoral angle.

Conclusions In the femoral *procurvatum*, the gold standard surgery is represented by the *procurvatum* osteotomy so, a tibial osteotomy, sometimes practiced in case of capsulo-ligamentous *recurvatum*, will be avoided. In fact it will cause a para-articular double deformity and a *procurvatum* hyper-correction that brings to trochlear protrusion and gonarthrosis.

Neck talar directional osteotomy as a treatment of structured non osteoarthritic flat valgus foot

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Introduction A flat-valgus foot structured with pronatory dysplasia of the *coxa pedis* could be enhanced by resistance of constraints, the most crucial of which is the talar hypermetria, which causes its irreducible inferior-medial subluxation. When

chondral integrity of the subtalar joint exists, an alternative technique instead of arthrodesis consists in obtaining the shortening of the talar foot by a talar neck osteotomy-resection and cervical reorientation, that refocuses the head in the calcaneonavicular glenoid; as temporary support may be associated a tarsal sinus endorthesis with the effect “calcaneo stop”, in our series consists of the talar conical screw.

Methods We treated 61 patients, 35 males and 26 females, 25 operated in one side, 36 simultaneously right and left side; 22 % in age between 15 to 18 years, 41 % between the ages of 19 and 25, 28 % between 25 and 50, 6 % over 50 years; in 65 feet a calcaneo stop endorthesis was associated to the osteotomy. Forty-two patients were reviewed with a mean follow-up of 4 years, evaluation included a physical clinical and radiographic examination, assessment of the subjective aspects were investigated with specific questionnaire (VAS FA).

Results The results were morphologically very satisfactory, with the reappearance of arches and normalization of Kite and Costa Bertani angles, range 32°–147° and 25°–127°, pre-operative to post-operative respectively; consolidation were completed at an average of 75 days; we had one case nonunion, 12 cases between most aged have suffered from temporary regional algodystrophy; VAS FA score changed from 770 points pre-operatively to 1550 in the post-operative period; no pain in 71 % of cases, pain significantly diminished in 23 %, but in 6 % still episodic pain but less distressing.

Discussion The technique, published by B. Regnault, is a linear and precise a procedure, which must comply the talar endosteal blood-stream e and adopt an effective compressive osteosynthesis. Not widely diffused, was adopted by the first author of this paper since 1995, which has originally associated a tarsal sinus supporting endorthesis, this supplementary implant provides better stabilization, avoiding postoperative immobilization and allows a fast recovery of autonomy.

Conclusions The technique is effective in terms of mechanical and functional recovery aspects; allows a non demolitive correction of the anatomical deformity; the result is optimized by the use of conical talar screw; limits of this technique represented by the contraindication in case of osteoarthritis changes to the *coxa pedis*.

Retrograde nailing arthrodesis in distal leg deformities

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Introduction Distal leg and ankle deformities lead to progressive degeneration of the distal tibia and astragalic articular surfaces. When the cartilaginous degeneration is severe, or it is not possible to surgically correct the bone deformity, arthrodesis is the only surgical operation that is able to restore functionality. Retrograde nailing is a stable synthesis that leads to rapid healing of the bone surfaces, and precocious recovery. We assessed its application in articular distal tibia and ankle axial deviations.

Methods Between 2007 and 2012 we studied a group of 25 patients, 14 women and 11 men, mean age 43 years (min 31, max 74), affected by distal leg and ankle deformities. We divided them in 2 groups depending on the deformity site (tibia 11 patients, talus bone 14 patients). We assessed the surgical access, the corrective osteotomy site, the cancellous bone graft, the healing time through a modified AOFAS score and

X-rays, with a 3 years follow-up. Weight bearing was allowed 35 days post-operatively. The bone graft was harvested through peroneal malleolus resection, with the same lateral surgical access.

Results In all patients we achieved deformity correction. Bone consolidation occurred in 90 days. Nailing and preparation of the articular surfaces was associated to subtractive osteotomies in 9 cases. Five tibial osteotomies were performed mostly in post-traumatic deformities, 4 talus osteotomies mostly in degenerative deformities. A thin layer of cancellous bone graft was used 18 patients. Mean pre-operative AOFAS score was 37. At the 12-month follow-up, the score increased to 80, and it was maintained in the following examinations.

Discussion Retrograde nailing tibiotarsal arthrodesis with osteotomies is able to correct complex deformities with severe articular damage. Nailing makes this treatment more tolerable for patients comparing to techniques such as external fixation. Subtractive osteotomies or subtalar joint re-alignment are necessary in cases of severe rear foot deformities that prevent nail insertion.

Conclusions Retrograde nailing arthrodesis allows a complete correction of distal tibia and ankle articular deformities, a rapid consolidation and a precocious functional recovery.

SPINE 1

VK-100 elastoplastic: new vertebral augmentation technique

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Introduction Vertebroplasty and kyphoplasty are considered treatments of choice for osteoporotic vertebral fractures and, in selected cases, even for pathological fractures due to primary or metastatic bone tumors. Both techniques make use of PMMA (poly-methyl-methacrylate) cement. A new elastic polymer made by purified medical silicon (VK-100) was developed for both vertebroplasty and kyphoplasty. It is expected to be more biocompatible, decrease intra- and post-operative complications (i.e. fracture of the adjacent levels). The aim of the present work is to evaluate our preliminary results regarding the use of vertebroplasty with VK-100 for the treatment of osteoporotic and pathological vertebral fractures.

Methods Twenty patients selected (14 females, 6 males) diagnosed with osteoporotic vertebral fractures or pathologic fractures. All patients were pre-operatively assessed with X-rays and MRI STIR sequences and evaluated with CT post-operatively and during follow-up. Age less than 55 and/or fractures above T5 were considered exclusion criteria. All patients received the same percutaneous treatment (elastoplasty) with VK-100 through a trans-pedicle access (20 cases).

Results Average F.U. was 2 months (range 7–1). All patients reduced pain and were able to walk and stand in upright position post-operatively. No intra- nor post-operative complications (i.e. fractures of the adjacent vertebrae).

Discussion Percutaneous vertebroplasty and kyphoplasty with PMMA are commonly used to treat osteoporotic vertebral fractures. Kyphoplasty provided the theoretical advantage to restore the height of the vertebral body and decrease cement leakage rates. Despite this

we preferred vertebroplasty to kyphoplasty because the latter was not yet proved to be more effective being still more expensive.

Conclusions Even if good results in terms of pain control and patient satisfaction were achieved, use of PMMA might have major complications such as increased adjacent level vertebral fracture rate, release of toxic monomers secondary to the exothermic polymerization reaction, peri-vertebral cement leakage and pulmonary embolism. The new elastic polymer (VK-100) is a great choice instead of PMMA because it allows the same vertebral augmentation efficacy in terms of pain control and functional ability restoration, without the risk of using PMMA. Especially VK-100 biomechanical characteristics (elastic modulus) is related to a decreased risk of adjacent level vertebral fracture. Results are encouraging and further studies can provide long-term results and validate the procedure.

A new test for the evaluation of the erector spinae muscle: the Back Extensor Test (BET)

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Introduction The relationship between fracture risk and the strength of the erector spinae muscle has already been shown in literature, but the evaluation of muscle strength is normally calculated in body districts other than those directly related to vertebral fractures. Trunk stability is also important in back pain prevention and treatment. In the literature there is no agreement concerning how to evaluate the strength of the erector spinae muscle, its exclusive involvement and test's safety.

Methods The BET (Back Extensor Test) is a test, created in 2005 in the osteoporosis outpatient service of San Paolo Hospital in Milan. It consists in flexing your fully extended torso forward with an angle of 45° in the hips and measuring, in seconds, the time that the patients can maintain that position. To validate the BET we investigated 155 healthy voluntary subjects, 240 athletes, 75 patients of osteoporotic clinic.

Results We found good reproducibility (DS 8.38 CV 3.73). Inter-operator variability, seems to be statistically acceptable ($p = 0.002$), but needs further study. Good sensitivity and significance ($p < 0.001$) and statistically correlations with other common tests (Shoerber, Owesstry, VAS, Back Pain Function Test) were found. The BET proved to be a good predictor to identify pathologies of the spine and also a good indicator of athletic training ($p < 0.01$). We demonstrated a correlation between time and the BET area of the multifidus sonographically determined ($p < 0.001$).

Discussion Using BET on healthy and pathological subjects permitted to test his reproducibility and his correlation with differences in erector spinae muscle strength and permit to validate the BET as a good test for evaluating patients' therapy. Future developments concern the possibility of using BET to predict back pain recurrences and fragility vertebral fractures.

Conclusions BET seems to be a reproducible and practical test to be used to evaluate the possible correlation between erector spinae muscle strength and fracture risk in osteoporotic patients or to evaluate the efficacy of rehabilitation treatments in patient suffering of back pain.

Sagittal cervical alignment following single level anterior arthrodesis leads to degenerative changes in adjacent cervical intervertebral spaces: clinical and radiological results with a minimum 15-year follow-up

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Introduction Single level anterior cervical arthrodesis lead to the loss of movement at the interested level. The consequent functional overload on the adjacent levels may lead to degenerative changes of the intervertebral discs superior and inferior to the fused levels with a variable rate from 10 to 89 %. The aim of this study is to evaluate the clinical and radiological effect of sagittal segmental alignment (SSA) correction following single level anterior arthrodesis on cervical alignment and its relationship with the degeneration of adjacent levels.

Methods One hundred and seven patients (aged between 35 and 65 years) operated from 1980 to 1995 of anterior cervical arthrodesis according to Cloward technique were studied. Only patients with disc degeneration of a single level between C4 and C7, with no radiological signs of adjacent discs degeneration, were included. All patients were studied with orthostatic cervical spine X-rays. SSA, cervical spine sagittal alignment (CSSA) and the grade of degeneration of adjacent levels according to Kellgren and Lawrence classification were calculated in all cases. Patients were divided in 2 groups according to SSA values: in the group A 41 patients with SSA <0° (neutral or kyphotic); in the group B 66 patients with SSA >0° (lordotic).

Results Pre-operatively, mean SSA value was 0.6 ± 4 and mean CSSA 17 ± 9 . At last follow-up mean SSA was -2.8 ± 2 in group A and 4.8 ± 4 in group B; mean CSSA was 14 ± 6 in group A and 23.5 ± 7 in group B. Degeneration in adjacent segments was present in 60 % in group A and in 27 % in group B ($p < 0.05$).

Discussion Neck pain after selective cervical arthrodesis is the consequence of segmental degeneration. It is of paramount importance to prevent this complication by preserving lordosis in SSA during surgery.

Conclusions Anterior cervical arthrodesis according to Cloward is an effective technique for the treatment of cervical disc herniation and spondylosis. To prevent the degeneration of adjacent cervical levels we recommend to fix arthrodesis with a lordotic angle.

Efficacy of “NEURAC” post-operative rehabilitation method in patients who underwent microdiscectomy

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Introduction The aim of this study is to evaluate the effectiveness of the NEURAC method for the rehabilitation of patients which underwent lumbar microdiscectomy.

Methods We conducted a prospective randomized controlled study of 62 patients underwent single-level lumbar microdiscectomy between L3 and S1, aged between 18 and 65 years, who did not respond to drug therapy and who did not underwent surgery on the lumbar spine.

The study was conducted on two groups of patients: patients in the study group were treated with post-operative rehabilitation NEURAC method, those in the control group followed an ergonomic program. The evaluation was performed in the pre-operative (t1), at 1 month (t2) and at 6 months (t3). VAS back, VAS leg, ODI (Oswestry Disability Index), SF-12 were evaluated. For statistical analysis we used the SPSS software, version 16.0.

Results In the study group, there was a significant decrease in VAS back (t1 = 2.47, t2 = 1.75 and t3 = 1.44) and VAS leg (t1 = 2.56, t2 = 1.47 and t3 = 0.72) while in the control group VAS back was 2.28 at t1, 2.33 at t2 and 2.24 at t3; regarding VAS leg we recorded the following values: 3 at t1, 2.28 at t2 and 2.03 at t3. The value of the ODI for the study group was 24.31 at t1, 14.09 at t2 and 9.06 at t3 ($p < 0.05$); regarding the control group the value was 40.99 at t1, 23.99 at t2 and 16.07 at t3 ($p < 0.05$). As regards the analysis of the quality of life, there was a statistically significant improvement in both groups in the values of the SF-12 PCS, with values more comforting for the study group: 39.43 at t1, 42.25 at t2 and 51.3 at t3 against the following values of the control group: 34.22 at t1, 42.13 at t2 and 42.94 at t3.

Discussion The aim of NEURAC method was the reactivation of the stabilizing muscles of the spine inhibited by pain to re-establish a proper postural mechanism. The data analysis showed that this treatment protocol has a positive effect primarily on the lumbar pain and has a positive effect on quality of life after surgery due to a reduction of disability index.

Conclusions We believe that NEURAC treatment may be recommended as a method of rehabilitation after lumbar microdiscectomy, especially early post-operative. It remains to evaluate the long-term efficacy.

Clinical relevance and related factor with positive intraoperative swabs by culture in spine surgery: our experience

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Introduction Objective of the study was to assess the relevance of the positivity of swabs taken intra-operatively, in patients without clinical post-operative infection, with the development of a clinical apparent infection, and with a number of other variables.

Methods We analysed 78 patients treated surgically from December 2012 to October 2013. Mean follow-up was 5.5 months (1–11). All patients were treated at the same 2 operating theatres, of a single centre. The preparation of the sterile field took place according to standardized criteria. Swabs were taken, intra-operatively, at the end of the surgical procedure, before proceeding to the seam. The variables collected were: positive swab taken intra-operatively, by culture, type of surgery, presence of instrumentation systems, order surgery, duration of surgery, dose of antibiotic administered, any co-morbidity, possible revision surgery. All patients received antibiotic prophylaxis with Cefazolin 2 g for 1 h prior to surgery, and 1 g every 8 h, for the next 24 h. For interventions with a duration >3 h, was added a dose of 2 g Cefazolin iv. The parameters collected were processed statistically, in order to calculate sensitivity and specificity of the samples, and possible positive predictive value (PPV) and negative (NPV) of contracting an infection clinically manifested.

Results In 78 patients cohort, we found 20 positive culture tests (25.68 %), but only 6 patients (7.69 %) have developed a clinically apparent infection that required antibiotic treatment or debridement. There were no statistically significant relationships between the contamination of the patient and: the development of clinical infection, the use of instrumentation implants, co-morbidity, and revision surgery. Only four patients with positive culture (5.12 %) developed a superficial or deep infection of the surgical site. In one case the isolated germ was comparable. In the group examined, it was found a sensitivity of 16 % and a specificity of 77.8 %. The VPP was around 5 %, and the VPN around 91.8 %. The data analyzed showed that statistically significant relationships exist between the order of surgical planning and the development of infection and between the duration of the surgery and the development of infection.

Discussion It can be deduced that the intra-operative contamination of the samples, only in a few cases correlates to an infection occurs. For this reason it's ineffective and unnecessary to take intra-operative samples with diagnostic purpose.

Conclusions Future studies need to investigate the possible reliability of sampling biopsy, which could improve the reliability of positive microbiological examination.

Total lumbar disc arthroplasty: analysis of a personal series with a 10-year mean follow-up

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Introduction A retrospective analysis of clinical and radiological results was performed, aimed to evaluate the efficacy and longevity of 21 total lumbar disc arthroplasty (TDA) in patients with degenerative disc disease (DDD). It was also assessed the possible correlation between pain control and sagittal balance of lumbar spine. The pain is a problem with high social impact; one of the most common causes is the DDD. After the failure of the conservative treatment, surgery should be considered as a potential solution. The lumbar arthrodesis is considered the gold standard in the treatment of DDD. In recent years, the TDA has gained considerable popularity, and has been proposed, with appropriate indications, as an alternative to surgical lumbar arthrodesis.

Methods We analysed 21 patients with average age of 40 years (range 37–46 years), treated between 2000 and 2010 by the same surgeon. The mean follow-up was 9.28 years (SD 2.5). In all cases the inclusion criteria for total disc arthroplasty have been respected. Pain assessment and clinical outcome, was carried out through VAS questionnaires (Visual Analogue Scale) and ODI questionnaires (Oswestry Disability Index). The X-ray analysis was carried out by two independent operators, by pre-, post-operative, and the last ambulatory monitoring controls. The parameters analyzed were: disc height (DH), segmental lordosis (SL), and range of motion (ROM) of the treated segment. They were also looking for intra- and post-operative complication.

Results Statistical analysis of the results (Student's *t* test) showed a clinical improvement, expressed with the decrease of 5.3 points in average VAS scale, and 20.7 points in the ODI scale ($p < 0.05$). The implant of total disc arthroplasty resulted to an improvement of SL and DH in the treated segment in the immediate post-operative; the values reported showed no statistically significant changes in subsequent tests. The ROM medium was 6.18° (range 0–18). There were

no relationships between clinical outcome and ROM and pathology of the adjacent segment. The rate of complications that required a re-operation was 19 % (1 hematoma, 1 sciatica, 1 herniated disc in adjacent level, 1 LBP unresponsive to non-operative therapy). In two cases it has been found slight subsidence of a prosthetic component without any clinical significance.

Discussion The appropriate implant, related to the recovery of DH and SL, can lead to a restoration of sagittal segmental alignment.

Conclusions The proper indication for surgery, and the precise and accurate placement of the components are essential to ensure good results.

SPINE 2

Clinical and radiographic results in thoracic hyperkyphosis: surgical treatment considering the optimal fusion area

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Introduction Aim of the study was to evaluate in a retrospective way the clinical and radiographic outcome in patients underwent to posterior correction and fusion for thoracic hyper-kyphosis considering the appropriate proximal and distal fusion level.

Methods From 2006 to 2012 twenty-six patients, with a median age of 22.3 years (range 14–40) affected by idiopathic hyper-kyphosis and Scheurmann kyphosis underwent posterior fusion and Ponte osteotomies, in 2 different medical centre. Radiographic evaluation consisted of pre-operative postero-anterior and lateral X-ray and immediate and at last follow-up post-operative postero-anterior and lateral X-ray. In all patients the extension of the fusion area, the Cobb angle value, sagittal balance, appearance of junctional kyphosis at both fusion extremities or junctional discopathy, changes in anterior or posterior disc height were evaluated. SRS 22 was administered at pre-, post-operative time and at last follow-up for clinical evaluation. **Results** Median follow-up was 3.4 years (range 1.5–6). Good clinical results were observed in 24 patients; in 2 patients a poor clinical result was registered. No hardware failure was observed. In 17 patients the distal fusion area includes the first lordotic vertebra caudal to first lordotic disc, in 4 the sagittal stable vertebra, and in 5 the first lordotic vertebra corresponding to the stable vertebra. Radiographic analysis showed a Cobb angle correction of 50 %, unchanged at last follow-up ($p > 0.05$). A statistical significant correction in sagittal balance was reached in 87 % of the patients at immediate post-operative follow-up, unchanged at last follow-up ($p > 0.05$). In 2 patients a junctional kyphosis interesting the first disc caudal to the fusion area was observed with a decrease in anterior disc height of 70 % compared to the immediate post-operative time. In both cases the fusion area includes only the first lordotic vertebra. In both cases no significant sagittal balance alterations or significant clinical outcome changes compared to other patients were observed.

Discussion To avoid the onset of junctional kyphosis with a consequent loss of correction in hyper-kyphosis surgical treatment fusion area has to include at least the first lordotic vertebra caudal to first lordotic disc.

Conclusions Extension to the stable vertebra doesn't influence, in a statistical significant way, the clinical and radiographic outcome in our series.

Complications in lumbar spine surgery: retrospective analysis of 338 patients

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Introduction Surgical treatment of adult lumbar spinal disorders is associated with a substantial risk of intra-operative and peri-operative complications. There is no clearly defined medical literature on complication in lumbar spine surgery. Purpose of the study is to retrospectively evaluate intra-operative and peri-operative complications who underwent various lumbar surgical procedures and to study the possible predisposing role of advanced age in increasing this rate.

Methods From 2007 to 2011 the number and type of complications were recorded and both univariate, (considering the patients' age) and a multivariate statistical analysis was conducted in order to establish a possible predisposing role. One-hundred and thirty-three were lumbar disc hernia treated with microdiscectomy, 88 were lumbar stenosis, treated in 36 cases with only decompression, 52 with decompression and instrumentation with a maximum of 2 levels. Twenty-six patients showed a lumbar fracture treated with percutaneous or open screw fixation. Twelve showed a scoliotic or kyphotic deformity treated with decompression, fusion and osteotomies. Seventy were spondylolisthesis treated with 1 or more level of fusion.

Results Of the 338 patients who underwent surgery, 55 showed one or more complications. Type of surgical treatment ($p = 0.004$), open surgical approach ($p = 0.001$) and operative time ($p = 0.001$) increased the relative risk (RR) of complication occurrence of 2.3, 3.8 and 5.1, respectively. Major complications are more often seen in complex surgical treatment for severe deformities, in revision surgery and in anterior approaches with an occurrence of 58.3 %. Age greater than 65 years, despite an increased RR of peri-operative complications (1.5), does not represent a predisposing risk factor to complications ($p = 0.006$).

Discussion Spine surgery is related to inevitable risk of complications. Identify the main predisposing factors related to post-operative complications is very important in order to improve the clinical outcome. Several studies analyse this aspect, but in literature there's not a common consensus. In our study the most important factors related to post-operative complications are the presence of systemic diseases, alcohol consumption, smoke habit, nutritional status, mental and social life of the patient.

Conclusions Surgical decision-making and exclusion of patients is not justified only by due to age. A systematic pre-operative evaluation should always be performed in order to stratify risks and to guide decision-making for obtaining the best possible clinical results at lower risk, even for elderly patients.

Surgical treatment of degenerative lumbar scoliosis: study of a case series of 67 patients with a 10-year mean follow-up

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Introduction Degenerative lumbar scoliosis (DLS) is a spine deformity that occurs with chronic low back pain and progressive

radiculopathy, sparsely responsive to conservative treatment. Neurogenic claudication may be present in most severe cases. In this patient there is a loss of the coronal and sagittal balance (loss of lumbar lordosis, hyper-kyphosis). Radiographic studies can show different aspects of this disease, like segmental spinal instability, central or foraminal stenosis, or mixed forms. Actually in literature is possible to find many surgical option for this pathological condition, depending upon the clinical and radiological presentation. The aim of this presentation is to evaluate the effectiveness of PLIF technique in the treatment of DLS, both clinically and radiographically.

Methods Sixty-seven patients affected by degenerative lumbar scoliosis were treated between 1997 and 2013. The mean age was 65 years (min. 54, max. 75). The extension of the decompression and arthrodesis was planned based on the severity of the following factors: pain and neurological involvement, extension and characteristics of the stenosis (central, foraminal and mixed), instability and sagittal imbalance. In all cases weight-bearing and dynamic X-rays were performed. The clinical results were evaluated according to the Visual Analogue Scale (VAS) and the Roland-Morris Disability Questionnaire (RMDQ).

Results Posterior stabilization and decompression were performed as a single level in 8 cases, two levels in 18 cases and three or more levels in 41 cases. In 39 cases, posterior stabilization and intervertebral height restoration by PLIF were associated with the reinstatement of the coronal and sagittal balance. The mean follow-up was 10 years (min. 8, max. 12). Pre-operative VAS was 6.9 ± 1.9 , and improved to 2.3 ± 1.9 at follow-up. Pre-operative RMDQ was 16, it was 4 at follow-up.

Discussion Degenerative lumbar stenosis can result from several etiological factors, and may present with different clinical and pathological features. A careful study of all factors to classify degenerative scoliosis of the lumbar spine is necessary to give the correct indication for surgery and to obtain good results in the treatment of degenerative scoliosis.

Conclusions Surgical treatment of degenerative lumbar scoliosis by PLIF is a proper surgical option to avoid neurological complications if it's performed in a timely manner mode.

Posterior percutaneous screw-rod instrumentation is a safe and effective alternative approach to TLSO rigid bracing for single-level pyogenic spondylodiscitis

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Introduction Pyogenic spondylodiscitis (SP) is a potentially fatal affection. In most cases, patients present with a non complicated SP (known infectious agent, no neurologic compromise, and preserved spinal stability) and the treatment is based on intravenous administration of antibiotics and immobilization in a thoraco-lumbar rigid bracing (TLSO). Open surgery can be an alternative but is associated with a high number of complications. Minimally invasive surgery has recently been implemented to treat thoraco-lumbar SP. The objective of the study is to compare patient outcomes between TLSO and percutaneous surgical treatment.

Methods We conducted a retrospective study in a cohort of 27 SP patients. Fifteen patients received TLSO treatment for 3–4 months to complete healing, and 12 patients received percutaneous surgery. All patients were treated with antibiotic therapy. Patients were assessed for ESR, CRP, white blood cell count, segmental kyphosis, VAS, SF-12 and EQ5D for 18 months.

Results All patients healed within a similar time frame, and no complications were observed in the surgical group. A similar decrease in ESR and CRP was observed in both groups. Compared to TLSO

treated patients, surgically treated patients had lower VAS at 1 month ($p < 0.001$) and 3 months post-treatment ($p < 0.001$), higher SF-12 scores at 1 month ($p < 0.001$), 3 months ($p < 0.001$) and 6 months ($p < 0.05$) post-treatment, and higher EQ5D indices at 1 month ($p < 0.001$) and 3 months ($p < 0.001$) post-treatment. No differences were observed in segmental kyphosis pre-and post-treatment between the two groups.

Discussion These results suggest that percutaneous treatment ensures fast mobilization, avoids the complications of traditional surgery, and provides a significant improvement in the short term quality of life compared to TLSO treatment.

Conclusions Posterior percutaneous screw-rod treatment is a safe alternative to the more conservative TLSO treatment for non-complicated monolevel thoracolumbar SP.

Correlation between compliance and results of brace treatment in juvenile and adolescent idiopathic scoliosis

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Introduction Over the last years, evidence has accumulated in support of bracing as an effective treatment option in patients with idiopathic scoliosis. Yet, little information is available on the impact of compliance on the outcome of conservative treatment in scoliotic subjects. The aim of the present study was to prospectively evaluate the association between compliance to brace treatment and the progression of scoliotic curve in patients with idiopathic adolescent (AIS) or juvenile scoliosis (JIS).

Methods Among 1,424 patients treated for idiopathic scoliosis, 645 were eligible for inclusion criteria. Three outcomes were distinguished in agreement with the SRS criteria: curve correction, curve stabilization and curve progression. Brace wearing was assessed by one orthopaedic surgeon (LA) and scored on a standardized form. Compliance to treatment was categorized as complete (brace worn as prescribed), incomplete A (brace removed for 1 month), incomplete B (brace removed for 2 months), incomplete C (brace removed during school hours), and incomplete D (brace worn overnight only). Chi square test, Student's *t* test or ANOVA and ANOVA for repeated measures tests were used as statistical tests.

Results The results from our study showed that at follow-up the compliance was: complete 61.1 %; incomplete A 5.2 %; incomplete B 10.7 %; incomplete C 14.2 %; incomplete D 8.8 %. Curve correction was accomplished in 301/319 of complete, 19/27 incomplete A, 25/56 incomplete B, 52/74 incomplete C, 27/46 incomplete D. Cobb mean value was 29.8 ± 7.5 SD at beginning and 17.1 ± 10.9 SD at follow-up. Both Cobb and Perdriolle degree amelioration was significantly higher in patients with complete compliance over all other groups, both in juvenile, both in adolescent scoliosis. In the intention-to-treat analysis, the rate of surgical treatment was 2.1 % among patients with definite outcome and 12.1 % among those with drop-out. Treatment compliance showed significant interactions with time.

Discussion Our results indicate that the use of brace as prescribed may alter the natural history of AIS and JIS and that the type of brace influences the compliance.

Conclusions Curve progression and referral to surgery are lower in patients with high brace compliance. Bracing discontinuation up to 1 month does not impact on the treatment outcome. Conversely, wearing the brace only overnight is associated with a high rate of curve progression.

RESIDENTS' ORAL COMMUNICATIONS 1

Preliminary analysis of the biomechanical properties of plantar fascia in diabetic foot

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Introduction This work is focused in obtaining a preliminary evaluation of the mechanical properties of plantar fascia in donor patients submitted to amputation of the foot, in consequences of complicated diabetic/ischemic pathologies. The aim is to find possible correlations between structural alterations of plantar fascia and reduction of biomechanical functionality.

Methods Plantar fascia tissues are cut in smaller samples along the proximal–distal direction, which corresponds to the main orientation of collagen fibres and application of loads during stance and gate. The samples have dimensions characterized by an aspect ratio (length/width) of 3 to 1. Samples are tested at room temperature and hydration is kept with phosphate buffered solution pipetting. The method of mechanical investigation consists in the mechanical characterization of plantar tissues by means of two different experimental protocols, previously defined in the analysis of health plantar fascia. A first experimental protocol aims to assess fascial tissues elastic properties by means of different consecutive tensile tests applying increasing strain, within physiological range to avoid damage phenomena. A second experimental protocol has the purpose to characterize stress relaxation phenomena to estimate the visco-elastic properties of the tissue. Also in this case applied strain levels are within the physiological range. Stress relaxation phenomena are evaluated up to 300 s.

Results Results of mechanical tests show a certain degree of inter-subjects variability as regards the stiffness of the tissue and its dependence on strain. Stress relaxation tests highlight a greater homogeneity of the visco-elastic properties among different subjects.

Discussion The plantar fascia is an important structure of the foot. Although more cases are needed, our results suggest that the plantar fascia biomechanical properties are altered by diabetic pathology, particularly in the stiffness of the tissue.

Conclusions The evaluation and comparison of the mechanical properties of plantar fascia in patients affected by diabetes and subsequent neurovascular alterations of the foot are fundamental to understand the clinical consequences, the response to forces acting during gait and to prevent and treat this condition.

Analysis of bone remodeling in the revision of peri-prosthetic knee prosthesis with stems by diaphyseal densitometric evaluation

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Introduction Diaphyseal stemmed femoral and tibial implants in revision total knee arthroplasty (rTKA) lead to biomechanical

changes in lower limbs. The consequent different loads distribution causes peri-prosthetic bone remodelling. The aim of this study is to analyse the peri-prosthetic bone remodelling, its extent and the region of interest (ROI) where it occurs, by evaluation of the bone mineral density (BMD) changes.

Methods The nineteen patients enrolled in this study received rTKA with LEGION (Smith & Nephew Inc, Memphis, TN, USA) modular revision system. All implants had press-fit femoral and tibial diaphyseal stems. Only the femoral component and the prosthetic tibial plateau received cementation. The patients were analysed at 3, 6, 12 and 24 months and were divided in four groups according to the value of the canal fit ratio. Measurements of BMD (g/cm^2) were performed by dual energy X-ray absorptiometry (DXA) using a Hologic Scanner QDR 4500/Delphi bone densitometer and eight ROI were analysed for both femoral and tibial components.

Results All femoral implants had low press-fit stems and decreases in BMD were observed in R1, R7 and R4 with maximum values of: -13.6% in R1, -11.9% in R7 at 24 months and -2.5% in R4 at 12 months. About tibial component, similar results were observed in low-fit group. In high press-fit tibial implants BMD was increased in R4 (7.7% at 24 months) and a progressively lower decrease in BMD were observed in R1 and R7.

Discussion The prosthetic component implant cause a stress shielding which plays the most important role in the genesis of the peri-prosthetic bone remodelling. However, a high press-fit can reduce this shielding effect because of the best grip between the stem and the medullar canal walls and the consequent larger stimulation of bone growth.

Conclusions DXA analysis can evaluate successfully the type, the extent and the time progress of the peri-prosthetic bone remodelling. The fit of the stem is an important factor to determine the type and the extent of the peri-prosthetic bone remodelling.

Antegrade intramedullary nailing as a treatment of the three-part fractures of proximal humerus

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Introduction Which kind of surgical treatment should be used for the three-part fractures of proximal humerus is still under discussion. The purpose of this study is to evaluate when it is still possible to consider the antegrade intramedullary nailing as a right solution for this kind of fractures.

Methods Between January 2012 and December 2013, 57 patients affected by three-part fracture of proximal humerus underwent surgery. The average age of patients was 65 years old. In 35 patients we performed an antegrade intramedullary nailing with proximal locking for greater tuberosity. The remaining 22 patients were surgically treated using locking plate osteosynthesis, closed intramedullary pinning and, in the most severe cases, reverse shoulder arthroplasty or hemi-arthroplasty. Post-operative follow-up included clinical examination by using the Costant Score System, and radiographic assessments at 1, 3, 6, and 12 months.

Results A satisfactory general consolidation was obtained, according to the expected time for each patient. The total recovery was faster in patients over 60 years old who required a more rapid return to the daily activities. No post-operative complications, such as humeral head osteonecrosis, infection, delayed union, failed osteosynthesis, were observed. Mobilization of calcar screw was observed 3 months later in two patients affected by severe osteoporosis.

Discussion The proximal intramedullary nailing is effective in most of the patients. It is an useful surgery technique and it allows a faster functional recovery especially in patients over 60 years. Moreover, this implant represents a viable alternative to locking plate osteosynthesis.

Conclusions Our study confirms that the antegrade intramedullary nailing represents a right solution for the three-part fractures of proximal humerus, after a proper closed reduction.

Bovine vs. synthetic hydroxyapatite in hip revision surgery in osteoporotic patients: preliminary results

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Introduction Revision surgery of the hip often causes difficulties related to the management of bone defect, especially in the acetabulum. Although this bone defect often represents the direct cause of prosthetic failure, it can be worsened by an accidental iatrogenic removal of bone material that can occur while removing the prosthesis. In addition, another problem related to the another problem related to the advanced age of the patients is too often underestimated, i.e. osteoporosis. In fact, this disease accounts for a global bone loss, often pre-existing the bone defect itself. Given the different biological and mechanical properties, the purpose of this study is to assess whether there are significant differences between bovine hydroxyapatite (Orthoss) and synthetic one in the management of bone loss in revision hip surgery in osteoporotic patients.

Methods Female patients with type II or type III acetabular defect according to Paprosky and with primary osteoporosis diagnosed through DEXA (T-score <-2.5) were enrolled in the study. Patients were randomly divided into 2 homogeneous samples. Bovine HA and synthetic HA were used in patients of group A and B (control), respectively. Clinical (according to Harris Hip Score) and radiographic (according to the Benson classification) follow-up were performed at month 1, 3, 6, and 12. At month 24 a CT scan with 3D reconstruction and analysis of chrome-densitometry was obtained. The data were analyzed by mean of the Kaplan-Mayer curve (results yielding a p value <0.05 were considered statistically significant).

Results Based on the Harris Hip Score, there were no statistically significant differences between the 2 groups ($p < 0.05$) up to 12 months, while AT month 24, patients in group A showed higher scores. This data can be explained on the basis of the CT results. The 3D reconstructions and chrome-densitometry interpretation showed a better recovery of the bone defect and a consequent more effective osseointegration in group A.

Discussion The main end-point of the revision surgery is to achieve the stability of the system. A lot of different bone substitute are now usable. To have available a non human origin-bone substitute, with macroscopic and microscopic characteristics similar to the homologous graft, that represents the gold standard, is an important alternative for the bone defect treatment in hip revision surgery. This is more evident in case of bone defect associated with a poor quality bone. These two factors, together, represent a terrible synergy that threatens the implant success. Although at the beginning, to fill the bone defect may seem relatively simple, more complex is to restore, over the time, the quality of the bone and to obtain an acceptable quality of the local bone and a successful osseointegration.

Conclusions The accessibility to a material easily available, such as HA bovine origin, suitable for being both bone graft and bone graft substitute, able to allow a proper management of bone defect and, above all, good for a proper osseointegration, represents an essential resource for a good outcome in the medium and long term.

RESIDENTS' ORAL COMMUNICATIONS 2

Association of functional differences of cultured trochlear chondrocytes from subjects with symptomatic and asymptomatic patello-femoral pain

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Introduction Patello-femoral pain (PFP) etiology is still unclear, although the proteolytic matrix breakdown due to a trauma-mediated damage of chondrocytes appears to have a crucial role. Apoptosis is a tightly regulated process that is implicated in the removal of damaged or unwanted cells. Since there is no potential for replacing articular chondrocytes in the adult, apoptotic cell death of chondrocytes could be potential central factor in the onset and progression of condral lesions.

Methods Twenty participants, between the ages of 23–37 years, were recruited for the study. Ten women with PFP constituted the experimental group, whereas 10 pain-free women served as control group. Patients who meet the eligibility criteria, after signing the specific consent, were submitted to withdrawal of trochlea cartilage tissue. The specimen was obtained by needle-biopsy at 3 mm at the edge of the lesion and with extension in depth until subchondral bone. At the laboratory, each fragment was washed twice with PBS and chondrocytes isolated by enzymatic digestion with collagenase. The obtained suspension was appropriately filtered and centrifuged, then and after supernatant discharge the chondrocytes were plated on collagen-coated flask and evaluated by light microscopy. Variations in the intracellular redox state were evaluated in viral particle-transduced cells by means of EF1 α -LV-roGFP, a lentiviral-based vector coding for the redox sensitive version of the GFP protein (roGFP). Potential variations in chondrocytes apoptotic rate was evaluated by Apopercentage.

Results Chondrocytes from patients with PFP exhibited significant increased oxidative stress and apoptotic rate as compared with pain-free controls. The functional alterations observed in chondrocytes from the PFP group may reflect structural and biological differences in the trochlea cartilage of this population. Our data suggest antioxidant-based therapy as a potential treatment for PFP.

Discussion To investigate potential morpho-functional differences (e.g. oxidative stress, apoptosis, proliferation, collagen synthesis) among chondrocytes taken from lesions of the trochlea (I–II degree according to the classification of the international cartilage repair society) of symptomatic and asymptomatic subjects for PFP but with the same pathologic lesion.

Conclusions Since apoptosis and oxidative stress are widely considered crucial elements in the development of osteoarthritis, we believe our findings may be of extreme relevance in this context. Indeed, cell culture of trochlea chondrocytes with increased oxidative condition and apoptotic rate are associated with presence of PFP symptoms.

The evolution of subchondral bone after nanofractures: an experimental study

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Introduction During the last 30 years several techniques have been introduced to treat chondral lesions of the knee and today the therapeutic possibilities are considerably increased. Reparative treatments found their rationale in the stimulation of marrow elements of subchondral bone, with the aim of surgically inducing super-clot formation and then regeneration of a fibrous type of cartilage, tissue with poor biomechanical qualities and tendency to degeneration. Currently it is believed that one of the main causes of failure of microfractures could be represented by sclerosis of subchondral bone resulting in a process of reattachment of the bone in the area where the microfractures were performed. On the basis of these considerations, nanofractures have been recently introduced, in order to allow, through the execution of 9 mm depth and 1 mm diameter perforations, the direct stimulation of pluripotent stem cells that, following canals obtained with perforations, would be attracted to the site of injury, triggering reparative and regeneration processes.

Methods In January 2014, 8 female Sardinian sheeps were recruited, they weighed about 30–40 kg and they were maintained at the animal enclosures of the Department of Veterinary Medicine, in Sassari. In each animal were performed 0.5 mm diameter full-depth lesions in medial and lateral femoral condyles and subsequently, with the System NanoFx Arthrosurface, were performed, in order to favour the influx of stem cells and growth factors from cancellous bone, 5 holes with the formation of 9 mm depth and 1 mm width canals. Follow-up were performed ex vivo at 2 and 6 months from the execution of nanofractures and after adequate preparation, the explanted condyles were evaluated with high definition 3D CT (Micro-CT, image pixels corresponding to 12 μ m) in order to analyze the morphology of the subchondral bone and bone regeneration. On instrumental imaging different variables were assessed, including the structural and morphological changes in the subchondral bone, orientation, thickening and remodelling of cancellous bone and the behavior of the calcified cartilage.

Results Trabecular bone in the area subjected to nanofractures was found thickened by apposition of new bone tissue; furthermore the same area observed in sagittal scan shows how trabeculae form new interconnected arches, in relation to the procedure of nanofractures performed not only on orthogonal planes respect to the lesion.

Discussion Our current research has focused on the reparative phase, which is entrusted not only to the evolution of bone sclerosis and to the formation of a new tidemark, but it is also correlated to rigidity of cancellous bone. The evaluation of bone regeneration performed with high-resolution micro-CT allows to analyse the newly formed bone micro-architecture and to make a three-dimensional assessment of the structure and the bone mineral.

Conclusions Nanofractures, being less traumatic than other stimulation methods, allow to create a communication with a large number of trabecular canals and therefore a better access to bone marrow without compacting the trabeculae of surrounding subchondral bone. This technique seems to allow the development of subchondral bone tissue with more resistant fibres to compression loads and to shear forces, that are often responsible of bone failure at osteochondral interface level. Results therefore appear promising but we need more well-designed studies that include adequate histological evaluations and long-term results.

Does a thrombin-based topical haemostatic agent reduce blood loss and transfusion requirements after total knee revision surgery? A randomised, controlled trial

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Introduction Aim of the present study was to assess the efficacy of a thrombin-based topical haemostatic in reducing blood requirements after total knee replacement (TKR) revision surgery.

Methods We designed this prospective, randomized, controlled study to evaluate the haemostatic efficacy and safety of a thrombin-based topical haemostatic (FloSeal) versus standard treatment in patients receiving total knee revision arthroplasty. The decrease in haemoglobin values post-surgery and the blood units transfused were recorded. The decision to transfuse was made by a surgeon blinded to the patient's group allocation.

Results Forty-eight patients were enrolled in the study; twenty-four patients each were randomized to the treatment and control groups, respectively. The median decrease in haemoglobin concentration on the first postoperative day was 2.2 g/dl in the treatment group and 2.70 g/dl in the control group. A significant reduction in units of blood transfused was also observed in the treatment group compared with the control group [1.09 ± 1.13 (range 0–4) vs. 1.91 ± 1.41 (range 0–5) blood units; $p = 0.04$). No major treatment-related adverse events were recorded in the study.

Discussion An intra-operative bleeding always represent a surgical problem, as the procedure duration. A post-operative bleeding can let to a new operation. However the patient treatment delayed the post-operative hospital discharge, with increased costs. In this context the haemostatic tissue (FloSeal) with gelatinous matrix (bovine derived) of human thrombin high concentration, takes place the use is an effective method to reduce blood loss in 94 % of cases ($SD \pm 5$). The resorption of this product is biocompatible and occurs within 6 to <8 weeks, during the normal wound healing.

Conclusions A thrombin-based topical haemostatic reduced the need for blood transfusion in TKR revision surgery. A thrombin-based topical haemostatic can be an appropriate solution to enhance haemostasis and vessel sealing at the operative site in TKR revision surgery, in order to reduce blood loss after surgery, the risk of complications, and costs.

Outcomes of calcaneo-stop procedure in the treatment of juvenile flatfoot in young athletes

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Introduction The juvenile idiopathic flexible flatfoot is the most common condition treated by paediatric orthopaedic. Treatment is

mainly conservative, but may become surgical in symptomatic patients more than 8 years aged. The extended practice of sport in childhood and consequent increase of functional requirements have determined an increase of arthroereisis for the correction of flatfoot. The purpose of this study was to report on the results obtained in children that practiced sports, using the calcaneo-stop procedure.

Methods A total of 410 feet in 242 patients were treated using the calcaneo-stop procedure from January 1999 to March 2010. All patients followed a rehabilitation protocol avoiding running and jumping for 3 months. Of the entire study group, only 70 patients with a mean age of 13 years (range 8–15 years), bilaterally treated, who practiced usual sport activity were considered. A pre-operative and post-operative clinical evaluation using the Foot and Ankle Outcome Score (FAOS), a podoscopic examination and a radiographic assessment at a minimum of one year follow-up were performed.

Results The mean follow-up was 7 years. At clinical evaluation, FAOS system showed an average decrease of 21 % in symptoms and of 34.9 % in pain; daily function was improved by 17 % and quality of life by 52.7 %; sports performance were increased by 60 %. In 12 feet (8.6 %) heel valgus was observed, while the plantar arch was normalized in 128 feet (91.4 %). At radiographic evaluation the angle of Costa-Bertani had a mean decrease of $22.71^\circ \pm 6.54^\circ$.

Discussion The indications for surgical treatment of the juvenile idiopathic flexible flatfoot with calcaneo-stop procedure were represented by painful foot, fatigue, clumsiness during and after physical activity in patients more than 8 years aged. Sport activity restore came in an average time of 3 months after surgery and showed excellent outcomes, as reported by FAOS System, in which the average score of sport activity at follow-up was 97.1 ± 0.6 %. Success of technique was confirmed by radiographic evaluation, with an average improvement of 22.71° of angle of Costa-Bertani.

Conclusions The calcaneo-stop procedure is a simple and minimally invasive procedure that allows an early restore of sport activity in young athletes.

Hemi-corticotomy and one-stage bone transport for bone and soft tissues defects of the tibia with circular external fixator

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Introduction Osteomyelitis is a clinical condition that can become chronic and lead to the formation of sequestra, whose removal can create bone defects. Many options are available for treatment, depending on the extension of the infection, which aim at remove the sequestra, debride soft tissues and fill the bone defects. Our work aims at present our experience with external fixation in the treatment of patients affected by combined bone and soft tissues defects of the tibia with a single 1-stage procedure, including hemi-corticotomy, bone transport and soft tissues distraction.

Methods Between 2010 and 2012 we treated 5 patients (mean age 37.23 years) affected by chronic osteomyelitis of the tibia, as a consequence of open fracture or osteosynthesis. All the patients underwent pre-operative RMN/CT scans, sequestrectomy, soft tissues debridement, bone resection (mean length: 4.5 cm), external fixation and anterior hemi-corticotomy.

Results Mean treatment time was 12.4 weeks; in all the patients the gap was filled with no malunion. During treatment all the patients could walk and weight-bear and pain was controlled by therapy. In all

the cases bone fusion was gained and no patients had infection recurrences during the follow-up.

Discussion Although Ilizarov technique is widely accepted for treatment of long bones osteomyelitis, hemi-corticotomy is not as widely performed. To our knowledge, only one author published a work about this technique, but he preferred a two-steps approach, with a mean delay of 3 weeks between soft tissues surgical debridement and hemi-corticotomy. Our choice is different because it uses a 1-stage technique, which treats both soft tissues and bone at the same time.

Conclusions 1-stage anterior hemi-corticotomy permits to preserve posterior cortical bone, allowing bone and associated soft tissues defects to heal in a shorter time, and should be taken into consideration as a possible treatment option in selected cases.

Bone mineral density, pain and overall disability of the upper limb in women with trapeziometacarpal osteoarthritis

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Introduction The impairment of the trapeziometacarpal (TMC) joint reduced up to 50 % the functional capacity of the whole upper limb, since this joint plays a key role in the execution of almost all activities requiring grasping and handling. Although TMC osteoarthritis and osteoporosis are highly prevalent in post-menopausal women, the relationship between these conditions is poorly understood. The primary endpoint of this study was to evaluate the bone mineral density (BMD) at the distal one third of the radius in women with trapeziometacarpal osteoarthritis. The secondary outcomes were to evaluate the effect of TMC osteoarthritis on handgrip strength, pain and overall function of the upper limb.

Methods In this cross-sectional study carried out in Physical Medicine and Rehabilitation Outpatient Clinic, we included all patients with TMC osteoarthritis. Men and women under 50 years, subjects with other hand and wrist disorders were excluded from evaluation. All subjects were assessed with a comprehensive approach including measurement of handgrip strength, pain and hand disability, using the Brief Pain Inventory (BPI) and the Quick DASH scale (Disabilities of the Arm, Shoulder and Hand), and BMD at the distal one third of the radius, measured using dual energy X-ray absorptiometry (DXA).

Results In our population (39 women), the mean age was 69 years, the mean body mass index (BMI) was 27.7 kg/m². Our sample was divided into 2 groups, according to Eaton-Glickel classification: the first group (20 women, Eaton-Glickel stages 1 to 2) showed mean values of BMD higher than the mean BMD of patients in the second group (19 women, Eaton-Glickel stages 3 to 4) (0.722 vs. 0.603 g/cm², $p < 0.01$). The handgrip strength was reduced in both groups (11.5 kg in the first group and 8.6 kg in the second one), with a non-significant difference. Algo-functional assessment showed no significant difference between the 2 groups.

Discussion In our population the BMD at the distal 1/3 of the radius is significantly reduced in subjects with severe TMC osteoarthritis.

Conversely, the stage of articular surface involvement was not associated with handgrip strength, BPI indices and Quick-DASH score.

Conclusions The presence of TMC osteoarthritis could be impacting the forearm bone mass and overall functionality of the upper limb, even if it seems there is no close correlation between the level of severity of osteoarthritis and functional limitation.

Evolution of subchondral bone nanofractures: an experimental study

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Introduction Experimental study focused on a morphological subchondral bone marrow stimulation procedure that uses the nanofractures for the regeneration of hyaline cartilage.

Methods They have been used 8 Sardinian sheep, female weighing about 30–40 kg, maintained at the enclosure of the Department of Veterinary Medicine, Sassari, fed a ration of maintenance. In each animal were made at full-thickness lesions with a diameter of 0.5 mm on the medial and lateral femoral condyles and subsequently, with the recent development of specific instruments, were performed 5 perforations resulting deep channels 9 mm and 1 mm wide, which should facilitate the influx of stem cells and growth factors from cancellous bone. Four animals were suppressed at 2 months and the other 4 at 6 months after surgery; the condyles were harvested and prepared for the evaluation by the use of 3D CT (micro-CT, image pixels corresponding to 12 µm) high-definition capable of analyzing the morphology of the subchondral bone and bone regeneration (bone volume, tissue volume). Different values were taken into account, including: study of the structural and morphological changes at the level of the subchondral bone; the orientation, thickening and remodelling of bone trabeculae; the behaviour of the calcified cartilage; study the pictures of the model reproduced in 3D trabecular bone, micro-architectural changes, the network of channels.

Results The trabecular bone at CT study are thickened with neo apposition of tissue regeneration; the resistance to shear forces linked to the braiding trabecular bones, the absence of bone sclerosis, with a tide mark restored to the *status quo*, is relevant.

Discussion The bone repair is a complex process. Our current research focuses on the reparative phase, where the stiffness of bone is restored. Microcomputed tomography (micro-CT), applied in pre-clinical research is well validated to study the micro-architecture. The analysis of bone regeneration, based on micro-CT (higher resolution) allows clinical evaluations more reliable than radiographs for a three-dimensional assessment of the structure and bone mineral.

Conclusions The nanofractures, being more traumatic than other techniques, allow you to create a communication with a large number of channels trabecular and therefore better access to the bone marrow without compacting the surrounding subchondral bone trabeculae. This important surgical technique allows to develop a subchondral bone tissue with fibres more resistant to compression loads and to shear forces, which often are the most responsible for the failure of the bone at the interface level osteochondral.