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In-Depth Oral Presentations and Oral Communications

IN-DEPTH ORAL PRESENTATIONS

TISSUE ENGINEERING 1 (FIRST HALF)

Functionalized PCL surfaces drive osteo/chondrogenic differentiation of human bone marrow mesenchymal stem cells

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Objective Material-driven control of bone-marrow-derived mesenchymal stem cell (MSC) behavior and differentiation is a promising tool for osteochondral tissue engineering. Coupling micro-fabrication technologies to the functionalization with bioactive molecules may allow the production of effective bio-inspired scaffolds capable of mimicking the microenvironment of osteochondral tissue. The aim of this study is to evaluate the differentiating behavior of hMSCs cultured upon PCL surfaces functionalized either with chondrogenic or osteogenic growth factors, both associated with angiogenic or anti-antiogenic factors [1] in basal conditions.
Material and methods PCL surfaces were functionalized by chemical grafting technology either with TGF β1 or BMP 2 associated with angiogenic or anti-antiogenic factors such as VEGF-A and VEGF-B (antagonist of VEGF-A), respectively. These surfaces were produced as thin disks and placed in 96-well plates. hMSCs were cultured upon the bare (control) and functionalized PCL surfaces for 21 days in basal media. The samples were assayed for levels of viable cell adhesion, morphology and for the production of various differentiation and transcription markers such as STRO-1 (MSCs marker), Collagen type I, Osteopontin, Osteocalcin, Sparc (osteogenic markers), Collagen type II, Collagen type X, Aggrecan, Sox9 (chondrogenic markers) using fluorescent immunohistochemistry.
Results hMSCs cultured onto control PCL surfaces maintained their phenotype. TGF β1 functionalized surfaces induced chondrogenic differentiation of hMSC as confirmed by the positivity of chondrogenic immunostaining. hMSCs cultured upon TGF β1/VEGF-A surfaces showed positivity to the Sparc (Osteonectin) immunostainig. The positivity to STRO-1 of hMSCs cultured up all chondrogenic surfaces indicates the immaturity of the neo-chondrocytes. hMSCs cultured upon BMP 2 functionalized surfaces showed positivity of all osteogenic and slight positivity of the chondrogenic markers except to collagen X. BMP-2/VEGF-A surfaces showed an higher osteogenic induction on hMSCs with respect to other compositions.
Discussion and conclusions Results highlight the efficacy of functionalized biopolymer surfaces to drive the phenotype of hMSCs into the desired lineage of the osteochondral tissue. These findings may have a wide impact in tissue engineering and in stem cell biology, as the possibility to control stem cell differentiation via cell/biomaterial interactions could result in the production of more efficient and effective osteochondral tissue engineering constructs.
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Biologic scaffold for rotator cuff tendon regeneration

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Management of irreparable or degenerative rotator cuff tears or re-tears is still a major challenge in shoulder surgery.
One treatment option is to reinforce the tendon applying a biological scaffold with augmentation or bridging function. In particular Graft Jacket allograft showed in vitro and in clinical study good results [1, 2], but it is commercially available in USA, and not in Europe.
The necessity of a biological and safe scaffold pushed us to create a multidisciplinary team to produce it. An innovative technique to decellularize dermis from organ and tissue donors were found, and a biocompatible and bioactive human dermal matrix was developed.
The histological and mechanical tests and in vitro studies performed confirmed adequate characteristics of the scaffold. After Rizzoli Orthopaedic Hospital Ethical Committee approval, the clinical application started.
In about 200 rotator cuff repairs performed during the period June 2009–May 2010 we selected 7 young and active patients with massive lesions and bad quality tendons. The patients were all males with an mean age of 45 years. The patients were followed with clinical, ultrasound and MR evaluation.
Although the low number of cases and the brief follow-up do not permit a complete final evaluation, good clinical and imaging results were obtained in the absence of inflammation or infections.
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Human bone marrow stromal cells cultures in hydrogels: a novel perspective to improve osteo-integration of titanium implants

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Objective Titanium is widely used for several medical implants and many surface treatments have been developed to enhance osteo-integration of implants, however, the interface between graft and bone remains the weakest point during the initial healing period [1]. Hydrogels are easily colonized by cells and may represent an alternative approach to titanium implants coating in order to improve the osteointegration. In this study we tested the properties of an amidated carboxymethylcellulose hydrogel (CMCA), obtained by converting about 50% of carboxylic groups of carboxymethyl-cellulose into amidic groups, that has been previously used as a support for condrocytes growth and differentiation [2]. We evaluated the ability of bone marrow stromal cells (BMSCs) to adhere and grow on this biomaterial since these cells possess a great osteogenic potential and have already been successfully used for bone regeneration applications [3].
Material and methods In our study we isolated BMSCs from patients undergoing total hip replacement. We analyzed the cytotoxicity of CMCA at different time points and evaluated the adhesion and viability of cells cultured on CMCA in the presence of osteo-inductive medium. In order to set up a reproducible seeding procedure we aliquoted fixed volumes of CMCA in 24-multiplates; hydrogels were then air-dried, rehydrated with a cellular suspension (1×10^5 BMSCs) and maintained in osteo-inductive medium.
Results CMCA did not show any significant cytotoxic effect on BMSCs. Cells were able to colonize CMCA, with a full-thickness distribution, and to maintain their viability as shown by Live/Dead assay; these observations at fluorescence microscopy were confirmed by Alamar Blue viability test.
Discussion Our results showed that CMCA hydrogel was a good support for BMSCs viability, demonstrating that CMCA is a suitable material for culture and osteogenic differentiation of BMSCs.
Conclusions These preliminary results showed that CMCA hydrogel may be considered a promising candidate for future clinical applications in the field of bone tissue engineering; indeed, this biomaterial enriched with autologous bone marrow stromal cells (BMSCs) may be used in combination with trabecular titanium implants in order to improve and accelerate their osteointegration.

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Novel magnetic nanoparticles approaches in bone and osteochondral tissue engineering

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Tissue engineering has recently emerged as a multidisciplinary approach for the treatment of bone/osteochondral defects. Scaffolds with the potential to circumvent the limitations of autologous and allogenic tissue repair are employed to restore tissue functions. This project proposes magnetic scaffolds that via magnetic guiding will be able to attract and take up in vivo growth factors/stem cells bound to magnetic nanoparticles.
Magnetic scaffolds are prepared following two different methods. In the first strategy, apatite/collagen porous scaffolds are prepared by nucleating biomimetic apatite on self-assembling collagen fibres and then these bio-hybrid composites are infiltrated by ferrofluids. The magnetic nanoparticles are therefore entrapped in the construct leading to the magnetization of the scaffold [1]. The second approach is based on the direct nucleation of biomimetic apatite on self-assembling collagen fibrils in presence of magnetite nanoparticles realizing the magnetization of the scaffold material in situ. The scaffolds become magnetic maintaining their specific porosity and shape and the analysis reveals a low percent of released magnetite after 8 days in simulated body fluid.
In vitro biocompatibility of magnetic scaffolds analysis with human mesenchymal stem cells (hBMSCs) showed the ability of these new magnetic scaffolds to sustain cell adhesion and proliferation, since there are no significant differences in the level of living/dead cells between control scaffolds and magnetized scaffolds. hBMSCs adhere and attach firmly to the scaffold surfaces and are shown to penetrate inside the scaffold.
In vivo biocompatibility of magnetic scaffolds is tested in a rabbit model implanting scaffolds in the tibial diaphyses and femural epiphyses. Preliminary results show good biocompatibility and bone integration with no inflammation reaction even on organs biopsies. The proposed scaffolds work like magnetic local field amplificators: their relatively strong magnetization can be aligned in the same direction by moderate external field. For magnetic targeting, growth factors/cells are bound to nanoparticles, introduced in the body, and then concentrated in the target area by means of an externally applied magnetic field.

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Genetic effects of pulsed electromagnetic fields on human osteoblastlike cells (MG-63)

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Objective Although pulsed electromagnetic fields (PEMFs) are used to treat delayed unions and nonunions, their mechanism of action is not completely clear. Moreover, PEMFs are known to affect the expression of certain genes. We asked (1) whether PEMF affect gene expression in human osteoblastlike cells (MG63) *in vitro*, and (2) whether and to what extent stimulation by PEMFs induces cell proliferation and differentiation in MG-63 cultures.
Material and methods We cultured two groups of MG63 cells. One group was treated with PEMFs for 18 h whereas the second was maintained in the same culture condition without PEMFs (control). Gene expression was evaluated throughout cDNA microarray analysis containing 19,000 genes spanning a substantial fraction of the human genome.
Results PEMFs induced the upregulation of important genes related to bone formation (HOXA10, AKT1), genes at the transductional level (CALM1, P2RX7), genes for cytoskeletal components (FN1, VCL), and collagenous (COL1A2) and noncollagenous (SPARC) matrix components. However, PEMF induced downregulation of genes related to the degradation of extracellular matrix (MMP-11, DUSP4).
Discussion and conclusions PEMFs appear to induce cell proliferation and differentiation. Furthermore, PEMFs promote extracellular matrix production and mineralization while decreasing matrix degradation and absorption. Our data suggest specific mechanisms for the observed clinical effect of PEMFs, and thus specific approaches for use in regenerative medicine.

TISSUE ENGINEERING 1 (SECOND HALF)

The role of PRP in muscular and tendon lesions: our protocol

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Muscular lesions represent one of the major causes of injuries during sport's activity with an incidence variable from 10% to 55% of all traumas. From a therapeutic point of view, standard treatments aim to reduce bleeding and should accelerate the healing process and improve the quality of the repaired tissue.
For these reasons it is necessary to focus on the different steps of the healing process: the inflammatory phase, the phase of repair of the damaged tissue and the fibrosis which comes afterwards. In these processes the regenerative medicine and the tissue engineering can be useful, with the therapeutic use of growth factors, inhibitors of the fibrosis, stem cells and gene therapy.

Unfortunately at this point there are no prospective randomized studies which can give us the correct indications to improve and enhance the healing process of muscular lesions and because of this lack of literature we decided to use PRP in athletes only in case of pure muscular lesions, in general of not surgical interest, with a protocol that we designed on the basis of the experience and which presents these indications and steps:

- Pure muscular lesions at least at II stage;
- Not before 48 h, within 15 day from injury;
- At least 2 injections at 7–10 days distance;
- MRI before first injection and control MRI at 4 weeks
- Rehabilitation program: rest for 15 days, than stretching and eccentric exercises that can be associated with neuromuscular stimulation.

Concerning mio-tendinous lesions in the athlete, we should distinguish between lesions needing/not needing surgical treatment. In the first ones PRP can be injected at time of surgery intra-operatively, in the second ones the protocol described above can be followed.

In vitro effects of platelet rich plasma on different cells of the bone microenvironment

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Objective Although several authors have extensively studied platelet-rich plasma (PRP) to accelerate bone repair for clinical use, there are no definitive reports which explain the cellular mechanism underlying the observed clinical effects. The aim of this study was to evaluate the *in vitro* effects of PRP on proliferation and functions of bone microenvironment cells. Human bone marrow stromal cells (BMSC), osteoclasts, and human umbilical vein endothelial cells (HUVEC) were used as cell models.
Material and methods PRP was added to BMSC isolated from the iliac crest, and the effects on differentiation genes expression, cell-associated ALP, FGF-2 production and calcium deposition were evaluated at different end-points. The proliferation and expression of genes that have a role in bone repair was evaluated on HUVEC treated with PRP. Osteoclasts, obtained from human blood precursors, were treated with PRP and the formation of the F-actin ring, the number of tartrate-resistant acid phosphatase (TRACP)-positive multinucleated cells, and the ability to degrade collagen were evaluated.
Results PRP treatment favoured BMSC differentiation, as shown by an increased cell-associated ALP ($p = 0.019$), osterix ($p = 0.017$) and FGF-2 levels ($p = 0.05$). HUVEC proliferation was significantly stimulated by PRP, which also induced an increased expression of mRNA for PDGF-B (0.75 ± 0.06 *vs.* 0.59 ± 0.06 ctr), ICAM-1 (1.16 ± 0.09 *vs.* 0.5 ± 0.1 ctr), and osteoprotegerin (0.253 ± 0.05 *vs.* 0.066 ± 0.03 ctr). Moreover HUVEC treated with PRP favored BMSC recruitment ($p < 0.01$). The incubation with PRP supernatant at 10% concentration did not significantly affect the formation of TRACP-positive multinucleated cells that were able to form the F-actin ring. However, when PRP at 25 and 50% was added to the medium, the generation of TRACP-positive multinucleated cells was inhibited. PRP, even at 10% concentration, reduced the osteoclast-mediated bone collagen degradation, suggesting an inhibition of osteoclast activation.

Conclusions Platelet gel may contribute to bone healing through a favouring effect on both the differentiation of BMSC towards osteoblasts and angiogenesis. Platelet rich plasma not only stimulated the proliferation of endothelial cells, but also induced the expression of genes for adhesion molecules, for monocytes/macrophages and for the recruitment of osteoblast precursors. Moreover, PRP interfered with the complete differentiation process of human osteoclast precursors.

Platelet-rich plasma intra-articular injections versus viscosupplementation as a treatment for early osteoarthritis: a comparative study

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Objective Platelet Rich Plasma (PRP) is a promising support while treating cartilage defects. Aim of this study is to evaluate and compare the efficacy of PRP and viscosupplementation (HA) i.a. injections for the treatment of severe chondropathy of the knee.
Material and methods The study involved 150 patients affected by chondropathy and either early stage or severe osteoarthritis. Fifty symptomatic patients were treated with 3 autologous Platelet-Rich Plasma (PRP) intra-articular injections and evaluated prospectively. All patients were clinically evaluated at the enrolment, after the treatment and at 6 months follow-up. The results were also compared with two homogeneous groups of patients treated by HA injections in two different centers (High Molecular Weight Hyaluronan in one group, Low Molecular Weight Hyaluronan in the other). IKDC and EQ-VAS scores were used to clinically evaluate the patients, while their satisfaction and functional status were recorded.
Results Neither complications nor other major adverse events occurred among study subjects. Only minor adverse events were detected in some patients, as mild pain reaction and effusion after the injections, but they lasted for no more than a couple of days. At the follow-up evaluations, all groups showed a significant improvement in terms of function and quality of life. The comparison between the outcomes of the three groups showed a statistically significant difference ($p < 0.05$), reporting a superiority of the PRP group results.
Conclusions The use Platelet Rich Plasma is a simple, low cost and minimally invasive approach to osteoarthritis; it leads to a natural concentrate of autologous growth factors directly from the blood. Our clinical results are encouraging and suggest this method may be used to treat the degenerative articular pathology of the knee. Autologous PRP injections demonstrated a longlasting and better efficacy than HA injections in recovering articular function and reducing symptoms in patients affected by knee degeneration. However, Long-term and randomized controlled studies will be needed to confirm the reliability and evaluate the durability of this promising procedure.

An observational retrospective not controlled study on patients with long bones non-union treated with OP-1 (Osigraft): evaluation of results

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Objective Aim of this study is the evaluation of results of an observational retrospective not controlled study on patients with long bones non-union treated with OP-1 (Osigraft).
Material and methods We collected and analyzed data on a group of patients treated from January 2003 up to December 2009 at the Centro Traumatologico Ortopedico (C.T.O.) in Rome. The evaluation is relative to 67 patients (18 femurs, 29 tibiae, 16 humera, 4 forearms); patient's mean age: 33 ± 7 years (range 23–66); number of previous surgeries: 3.3 ± 2.3 (range 2–7); duration of non-union: 18.9 ± 20 months (range 9–93). In 25% cases a previous Iliac Crest Bone Graft (ICBG) was performed; in 53.3% cases Osigraft was used in combination with Autologous Growth Factors (AGFs) and/or ICGB. In 9 cases (13.4%) along with the use of Osigraft, a concomitant revision of the synthesis's device was performed.
Results Radiographic analysis at 9 months showed that OP-1 was effective in 78.6% of patients (67.9% union plus 10.7% marked bone bridging); a similar radiological outcome was observed in patients concomitantly treated with OP-1 and ICGB and/or AGFs. In patients treated with Osigraft only, radiographic union at 9 months was 82.4% (plus 3.6% marked bone bridging) with a definite increase of consolidation rate; we also observed an early radiological union at 4–5 months in 34.8% cases (Fig. 1).
Discussion and conclusions Although this trial is limited by its observational, not randomized nature, the results we obtained agree with similar results reported in literature by other studies randomized and not; we observed an efficacy of the concerned drug close or superior to 80% mainly in cases where Osigraft was used alone without concomitant Autologous Bone Graft and or AGFs use. The review of the failed cases force us to remember the basic principles of fracture treament: a careful osteosynthesis technique ensuring the proper mechanical stability, the continuity of bone, the contact of the drug with vital bone, the control of the infection.
Suggested readings

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Fig. 1 Radiographic union follow-up

The possible role of the transcription factor NF-kB on evolution of rotator cuff tear and on mechanisms of cuff tendon healing

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Introduction NF-kB (nuclear factor kappa beta) is a trascription factor that has an important role in the immune system. It regulates the expression of cytokines, cyclo-oxgenase 2, growth factors. It is a regulator of anti-apoptotic gene expression; it has a role in neo-angiogenesis stimulation and it plays a role during healing of the hand flexor tendonds. We verified if NF-kB is present on the margins of cuff tears and hypothesized that NF-kB might have a role on evolution of cuff tear and on possible mechanisms of cuff healing.
Material and methods Thirty-two consecutive patients with cuff tears were enrolled for this study (average age: 64 years). Tears were classified as small in 7 patients, large in 16 and massive in 9. Samples from anterior and posterior edges of the tear and portion of subacromial bursa were excised during the arthroscopic treatment. Samples of uninjured subscapularis tendon were also excised and used as control. Removed tissues were used for haematoxylin/eosin morphologic evaluation or for immunohistochemical analysis.
Results Activated NF-kB increases with the increasing in tear dimension without any differences between anterior and posterior edges, and it is always higher in the bursa. Of the subscapularis samples, only those belonged to patients with massive tears had the activated NF-kB. Inflammatory infiltrate is higher in the anterior edge of massive tears and in the bursa. Neoangiogenesis increases with the increasing in the tear dimension and it was particularly observed in the bursa.
Conclusions Activated NF-kB increases with the increasing in tear dimension. We hypothesized three possible explanations: (a) over time activated cells increase (accumulation effect); (b) massive tears are scarcely covered by the bursa, consequently tendon does not receive reparative biochemical stimuli; therefore cells active themselves in order to stimulate inflammation and neoangiogenesis; (c) activated NF-kB has an anti-apoptotic role on the remained cells.

INFECTIOUS DISEASES

Two-stage revision for infection in modular megaprostheses of the lower limb after resection for bone tumor

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Objective The aim of this study was to evaluate indications and results of two stage revisions in infected megaprostheses in lower limb.
Material and methods Between April 1983 and December 2007, 1036 modular uncemented megaprostheses were implanted in 605 males and 431 females with mean age 33.5 years: 160 KMFTR, 633 HMRS prostheses, 68 HMRS Rotating Hinge and 175 GMRS. Sites: distal femur 659, proximal tibia 198, proximal femur 145, total femur 25, distal femur and proximal tibia 9. Histology showed 612 osteosarcomas, 113 chondrosarcomas, 72 Ewing's sarcoma, 31 metastatic carcinomas, 89 GCT, 36 MFH,68 other diagnoses. Infection occurred in 80 cases (7.7%) at a mean time of 4 years (min 1 month, max 19 years) in 18 KMFTR, 47 HMRS, 5 HMRS Rotating Hinge, 10 GMRS. Sites: 51 distal femurs, 21 proximal tibias, 6 proximal femurs, 1 total femur and 1 extrarticular knee resection. Most frequent bacteria causing infection were: *Staphylococcus epidermidis* (39 cases), *Staphylococcus aureus* (17) and *Pseudomonas aeruginosa* (5). Infection occurred postoperatively within 4 weeks in 9 cases, early (within 6 months) in 12 cases, late (after 6 months) in 59 cases. Usual surgical treatment was "two stage" (removal of implant, one or more cement spacers with antibiotics, new implant), with antibiotics according with cultures. One stage treatment was used for immediate postoperative infections, only since 1998. Functional results after treatment of infection were assessed using the MSTS system.
Results A two stage revision was attempted in 73 patients (91.2%): in 58 cases a new prosthesis was implanted (with negative laboratory tests for infection) at a mean time of 5 months (min 2, max 16 months), but in 3 patients infection recurred and they were amputated; 4 patients died before implanting a new prosthesis; 11 patients were amputated after several spacers since infection did not heal. One stage revision was performed in 4 of the 9 immediate postoperative infections, with successful results. In 3 cases an amputation was primarily performed, to proceed with chemotherapy.

Revisions for infection were successful in 63 patients (79%), while 17 patients were amputated (21%). Functional results evaluated in 53 revised cases were good or excellent in 43 (81.1%).
Conclusions Two stage treatment of infected megaprostheses is successful in most cases. One stage has selected indications, mainly in postoperative immediate infections.

Epidemiological, clinical, and diagnostic features of osteoarticular tuberculosis in Naples area (Southern Italy)

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Objective We evaluated the epidemiological, clinical, and diagnostic features of osteoarticular tuberculosis (OT) in a series of cases seen over 30 years in a large University Hospital in Naples, Italy.
Material and methods We reviewed the files of all patients admitted to our Department from 1975 to 2004 with a diagnosis of osteoarticular tuberculosis. Ascertained notifications of tuberculosis for the 1996–2004 period were also obtained from the local Health Agency of Naples city.
Results The incidence of ascertained extrapulmonary tuberculosis and OT in the 1996–2004 period was 0.85 and 0.18 per 100,000 inhabitants, respectively. OT represented 19.2% out of all notifications for extrapulmonary tuberculosis. We identified one hundred and thirty-six patients with 140 osteoarticular tuberculosis lesions admitted at our Department over a thirty-year period. Fifty-three cases were diagnosed from 1975 to 1984, 36 cases from 1985 to 1994, and 47 cases from 1995 to 2004. Eleven patients (8%) were from high-incidence areas outside of Italy. The mean delay until diagnosis was 216.6 days. Pain, low-grade fever, and loss of weight were the most common presentation symptoms. Neurological involvement was present in 11 cases out of 79 spinal lesions (13.9%). Serological methods were used to study antimycobacterial antibodies using enzyme-linked immunosorbent assays (ELISA-TB test) in 59 patients (42.1%). Positive results on this test were obtained in 43 patients (72.9%). ELISA-TB test was the only diagnostic test associated with a shorter diagnostic delay in a model of multivariate regression analysis ($p = 0.001$). Tc-99 m MDP bone scans were obtained from 83 patients with 84 lesions and increased uptake in the affected area was noted in 72 lesions (85.7%). Histology and microbiological examinations were positive in 97 (69.3%) and 57 (40.7%) lesions, respectively. In 43 (30.7%) lesions, we could not definitively confirm the diagnosis. In these cases chemotherapy was nevertheless initiated.
Conclusions Thorough and even invasive diagnostic work-up is mandatory for the proper and timely management of patients with OT. Tc-99 m MDP bone scanning and ELISA-TB test are useful diagnostic tools. We always used microbiological testing and histological examination to confirm the diagnosis of OT, but empirical anti-tuberculosis treatment was nevertheless initiated in patients with high clinical suspicion in order to limit the potentially permanent destruction of affected skeletal segments.

Anti-bacterial finishing of hospital textiles for nosocomial infections prevention

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Objective WHO data show that 8.7% of hospitalized patients will develop a nosocomial infection. In Italy, about 6.7% of hospitalized patients become infected, i.e. between 500,000 and 700,000 individuals, with 5000–7000 related deaths and an estimated extra cost of 1 billion Euros/year. Bacteria contaminate surgical fields. Knobben et al. (2006) found an intra-operative contamination rate ranging from 8.6% to 34.3% in hip and knee prosthetic surgery. Da Costa et al. (2008) showed that 10% to 30% of instruments are contaminated in the surgery room, while surgical gown, considered sterile, are in fact contaminated at the end of a surgical spinal procedure at rates ranging from 6% to 48% (Bible et al., 2009). Different technologies are now available to provide anti-bacterial properties to textiles. However they have not been tested for hospital application yet. Aim of this study has been to assess the in vitro and clinical efficacy of a novel anti-bacterial finishing of textiles in a hospital environment.
Material and methods The SANIT anti-bacterial finishing treatment of hospital textiles (ALSCO Italia, S.p.A.) was evaluated in this double blind, prospective, in vitro and clinical study. 0.2% and 0.4% finished textiles have been evaluated in vitro as concerning growth inhibition and killing of multi-resistant strains of *S. aureus* and epidermidis, *Pseudomonas aeruginosa*, *E. coli*, *Klebsiella*, Enterococchi and Candida. A second part of the study consisted of cultural examination of sterile and non sterile dressings and gowns used in the clinical setting and in the surgical field with and without the SANIT treatment.
Results *In vitro* study showed the ability of the anti-bacterial finishing to inhibit staphylococcal growth, compared to controls, with bacterial killing in less than 5 min. The clinical study demonstrated a reduction of bacterial count in the treated textiles of >3 log. No skin allergic reactions or contact erythema has been observed with the prolonged (>10 days) use of the treated textiles.
Discussion SANIT, an anti-bacterial finishing, has been proven to be effective in inhibiting bacterial growth in commonly used nosocomial textiles, in the absence of skin reactions. This technology allows to restore the initial anti-bacterial properties of every dressing at each washing procedure and to fit the degree of textile anti-bacterial protection according to the specific needs.
Conclusions A large scale application of this low-cost technology has the potential to reduce the contamination in hospital environment and thus the spreading of nosocomial infections.

NEOPLASTIC DISEASES (FIRST HALF)

Sarcomas in Paget's disease: experience at the Rizzoli Institute

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Objective Sarcoma is a rare complication of Paget's disease with an incidence of about 1%. Treatment is controversial: the older age of the patients affected by Paget's disease may limit the use of chemotherapy and axial involvement may limit the practicality of surgery. The purposes of this study was to analyze treatment, results and survival in patients treated for sarcoma in Paget's disease, in a single Institution.
Material and methods We retrospectively reviewed the medical records of 37 patients treated between 1961 and 2007 who had bone

sarcoma arising from a site of Paget's disease. Most of the patients were aware of the diagnosis of monostotic (80%) or polyostotic (20%) Paget's disease, while in the other cases the diagnosis of Paget's disease and sarcoma was simultaneous. Osteosarcoma (26 patients) was the most common histotype and was divided into osteoblastic (69%), fibroblastic (19%), telangiectatic (8%) and chondroblastic (4%) subtypes. The remaining 11 cases were spindle cells sarcomas (9 fibrosarcomas, 2 originally classified as malignant fibrous hystiocytomas). Twenty-two of the 26 patients with osteosarcoma had surgery. In six surgery only was performed; three had surgery, adjuvant chemotherapy, and radiotherapy; one surgery and radiotherapy; 12 underwent surgery and chemotherapy (adjuvant in ten patients and neoadjuvant in two); two had only radiotherapy and two had only chemotherapy. We performed survival analyses between various combinations of treatment.

Results Four patients had no evidence of disease (NED) at a minimum follow-up of 42.6 months (mean, 139 months; range, 42.6–257.4 months) and 22 died with disease (DWD) at a mean time of 20.2 months (range, 1–84 months). One of the six patients (11%) treated with surgery only is NED at 10 years; the other five died from disease at a mean time of 30 months. Three of 12 patients (25%) treated with surgery and chemotherapy are NED at a mean follow-up of 12 years; nine died of disease at a mean of 24 months. All patients treated without surgery died at a mean of 7.5 months (range, 1–13.7 months).

Conclusions Despite improvements in surgery and medical treatments the prognosis for patients with Paget's sarcoma remains poor. Chemotherapy combined with surgery can improve life expectancy in selected cases.

Pelvic massive allograft reconstruction after periacetabular bone tumor resection

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Limb salvage surgery is challenging in pelvic bone tumors. Adequate surgical margins are difficult to achieve and resections involving the acetabulum require demanding reconstructive procedures. Several techniques have been described after periacetabular resections including flail hip, reconstructions with modular or custom made pelvic prostheses and the use of autograft or allograft coupled with a total hip prosthesis The objective of the present study was to review the outcome of patients treated by periacetabular bone tumor resection and reconstruction with pelvic massive allograft and total hip prosthesis.

This series includes 25 patients (diagnosis: 22 high grade sarcoma, 1 giant cell tumor, 1 metastatic carcinoma, 1 plasmocitoma) treated with periacetabular resection between 2000 and 2010. The mean age at time of surgery is 31 years (16–68). Reconstruction was performed with fresh-frozen pelvic allografts, cemented femoral prosthetic stems and self-retaining cemented polyethylene cups with rehinforcement acetabular rings. Allograft fixation was achieved with plates and screws or screws alone when the entire hemypelvis was replaced. Fifteen patients received chemotherapy and 7 patients radiationtherapy.

A local recurrence of the tumor was observed in 3 cases and 9 patients presented a metastatic dissemination. Eight patients died as consequence of primary disease and one patient died of other cause. Two patients were alive with disease progression. Three patients had less than 12 months follow-up. The remaining 11 patients were observed at a mean follow-up of 50 months (14–120). Functional results were evaluated following MSTS classification and were excellent in 3 (77%–90%), good in 5 (53%–73%), fair in 2 and poor in 1 case. Early postoperative complications included 6 sciatic nerve palsies (2 persistent after one year) and 4 hip dislocations, healed after closed reduction and brace immobilization in 2 cases and open reduction in 2 cases. Four patients presented a deep infection (16%), requiring allograft removal in two cases and healed after surgical debridement in two cases. Late complications included one cemented cup loosening treated with surgical revision and double motility cemented cup implant. One patient presented periarticular heterotopic ossification without functional impairment.

Pelvic massive allografts allowed an anatomical and functional reconstruction in periacetabular resections. Limb salvage was successfully achieved in our series. Seven patients (28%) required surgical revision and none was amputated for any complication or local recurrence. Pelvic allograft resulted to be an effective reconstructive option after periacetabular resections although their use should be reserved to selected cases.

Treatment of secondary lesion of the pelvis: our experience

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Objective The bone is one of the most common site of secondary lesions in patients with cancer [1]. Secondary involvement of the skeleton leads to profound disability with reduction of quality of life to relate the onset of pain (sometimes difficult to manage with common drug treatments) and the high incidence of pathological fractures. Solid cancers metastasise to bone by a complex multistep process which involves interactions between tumour cells and normal host cells. There is the necessity to find a treatment of these lesions which reduces pain, improve mobility and function, restore the mechanical characteristics of the segment affected.

Material and methods Six procedures of coblation and cementoplasty of secondary lesions of the pelvis were performed between 2007 and 2009 (Fig. 1). This method is based on our experience acquired during the treatment of secondary lesions of the spine by coablation and vertebroplasty [2, 3]. The histological types of primary tumors treated were: 3 lung cancers, 2 bladder cancers and 1 colorectal cancer. The technique involves the introduction of a trocar under

Fig. 1 Procedure of coblation and cementoplasty of secondary lesions of the pelvis

fluoroscopic guide in the context of the lesion, the coblation of pathological tissue using radiofrequency and subsequent injection of cement (PMMA).

Results Immediate post operative has shown a marked improvement in pain that persists at short-term follow-up (average 6 months). No fractures in the treatment site were observed and major complications were not reported.

Conclusions The coblation and cementoplasty of the secondary lesions of the pelvis has proved to be a valuable palliative treatment approach. This treatment allows a main reduction of pain with improved mechanical characteristics of the affected skeletal segment. The analgesic effect appears to be explained by the thermal shock that follows coblation after injection of PMMA, which polymerizes at a temperature of 70°. The cement is inserted in the trabecular bone of the pelvis and causes a significant increase of mechanical resistance to load, contributing to pain relief and improving the quality of remaining life.

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Multiple myeloma: pathogenesis of the osteolysis and critical aspects in the orthopaedic management

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Multiple myeloma (MM) is a malignant tumor formed by the proliferation of B-lymphocytes and plasma cells synthesizing monoclonal immunoglobulins. It is mainly characterized by osteolytic lesions, pathological fractures, hypercalcemia, progressive renal failure, anemia and immunodeficiency that can show different clinical patterns. The skeletal complications, represented by pathological fractures, bone pain and spinal cord compression, derive from the osteolysis caused by uncoupling of the activity of bone cells, due to osteoclastic hyperactivation and osteoblastic inhibition. Such activity, mainly regulated by the RANK/RANKL/OPG system, is altered by an excessive production of RANKL (Receptor Activator of Nuclear factor κ β Ligand) with contemporaneous inactivation of OPG (Osteoprotegerin). Furthermore the action of other cytokines is also possible, such as Macrophage Inflammatory Protein-1α (MIP-1α), Wnt System, Vascular Endothelial Growth Factor (VEGF) and Transforming Growth Factor-β (TGF-β), that can act either altering the RANKL/OPG pathway or directly influencing bone cells [1]. In fact, the main localization of myelomatous cells at the level of the lytic lesions emphasizes the importance of their direct interaction with the stroma cells, and the significance of the factors released, both locally and systemically. Although osteolytic lesions can affect any skeletal site, they are mainly localized at the level of the axial skeleton (spine, skull, ribs and pelvis) and of the proximal regions of long bones (femur and humerus). X-rays of the whole skeleton and further radiological investigations such as CT, MRI and PET, are essential instruments that allow estimation of the skeletal involvement both at diagnosis and during treatment [2]. The treatment includes chemotherapy, a new generation of non chemoterapeutic drugs, autologous or allogenic stem cells transplant, bisphosphonates, radiotherapy and surgery [3]. The last one includes not only fracture treatment (i.e. vertebro-kyphoplasty or intramedullary nailing), but also the prevention of impending fractures and the treatment of the possible neurological compressions. Beside the new therapies that aim to restore the molecular status as before the neoplasm, the support of orthopaedic treatment is essential to eliminate pain and to treat and prevent pathologic fractures, in order to improve the quality of life of the patient.

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Multidisciplinar treatment and clinical outcome of 27 patients affected by chordoma. The Regina Elena National Cancer Institute "Sarcoma Group" experience

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Objective Adequate surgery still remains the mainstay of treatment of chordoma; however, some interesting clinical data of response with molecularly targeted therapies were reported.

Material and methods We described the clinical outcome of a series of chordoma patients followed at Regina Elena National Cancer Institute of Rome by a dedicated multidisciplinary team including orthopaedic surgeons, oncologists, radiotherapists, pathologist and radiologists (Sarcoma Group).

Results Twenty-seven patients with sacral (n = 12), spine (n = 14), and skull base (n = 1) chordoma were evaluated from 2004 to 2010. Sex: 19 male, 8 female. Median age at diagnosis: 65 years (range: 40–77). Six patients (22%) had a primary disease, 16 (59%) a recurrent disease, and 5 (19%) a metastatic spreading. Surgery was the primary treatment in 24 out of 27 (89%) patients. Surgical margins were wide in 6 (25%) and intralesional in 17 (75%) patients; in 3 out of 4 in-house treated patients, wide margins were obtained. Seventeen out of 18 (94%) patients with intralesional margins underwent local progression at a median time of 20 months with a 2-year local progression-free survival of 48%. The 5-year metastasis-free survival rate was 80%. Twenty-one patients with locally advanced/metastatic disease expressing platelet-derived growth factor receptor (PDGFR) beta were treated with imatinib mesylate in the context of a multicenter phase II trial and of a drug expanded access protocol. A RECIST stabilization of disease was the best response observed in 19 out of 21 evaluable cases. Pain relief with reduction in analgesics use was obtained in 6 out of 11 (54%) symptomatic

patients. The 5- and 10-year survival rates of the entire series of patients were 78% and 60%, respectively.
Discussion and conclusions Despite the progress of surgical techniques and the results obtained with targeted therapy, chordoma still remains an invalidant disease not infrequently complicated by the occurrence of metastatic spreading. Specific experience of the multidisciplinar therapeutic team is, however, essential in the management of this rare bone tumour in order to offer the better chances of treatment to the patients and to improve their quality of life.

NEOPLASTIC DISEASES (SECOND HALF)

Spinal cord compression in spine metastases: treatment indications

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Objective The aim of this study is to define the surgical treatment in metastatic patients with SCC and to decide what type of surgery is the best choice for these patients.
Material and methods We reviewed the literature concerning prognostic factors related to survival and neurological outcome.
Results Many prognostic factors are reported: performance status, primary tumour, visceral metastases, free interval, neurological status, time of developing motor deficits, other bone metastases, pathologic fracture, other vertebral metastases, age, extension and localization, response to radiotherapy. Many scores are reported in literature (Rades, Tokuhashi, Tomita, Bauer, Sioutos, Van der Linden, Enkaoua, Katagiri, Harrington, Asdourian, Boriani), but there is not an agreement on which has to be considered the most accurate to predict survival and surgical approach. Following a review of the studies reported in literature we can gather that surgical treatment is indicated when there is: (a) spine instability; (b) neurological symptoms; (c) life expectancy >3 months; (d) paraplegia <48 h; (e) istotype resistant to radiotherapy; (f) compression due to bone fragment; (g) pain resistant to other treatments; (h) failure of radiotherapy; (i) not ambulatory patients with one level of compression; (l) ambulatory patients with negative factors to radiotherapy; (m) good PS.
Discussion Standard treatment consists in dexamethasone and radiotherapy. Today, decompression with only laminectomy is inadeguate. However, many studies report better results with surgery and postoperative radiotherapy. Other authors suggest a preventive surgery, performed at the beginning of clinical symptoms, to obtain good neurological outcome. All approaches (anterior, posterior or combined) with different percentages and types of complications and all kinds of excision of bone metastasis with different oncological results are possible, but all surgical procedures must be always followed by a spine stabilization.
Conclusions With the increasing survival of the metastatic patients, treatment will have to be differentiated according to primary tumor because of different possibilities of response to different kinds of managements. So surgery may be indicated in a metastatic lesion due to a kidney cancer but not in the same lesion from a breast cancer. However, in every score, it is possible to deduce four different types of managements: (a) no surgical treatment in patients with survival <3 months; (b) a palliative therapy: laminectomy and stabilization, indicated in patients with severe prognosis, survival 3–6 months; (c) adjuvant treatment: curettage of the lesion, indicated in patients with fair prognosis, survival 6–12 months; (d) "radical" treatment: en-bloc resection of the metastasis, indicated in patients with good prognosis, survival >12 months.

"Internal bracing" surgery in the treatment of solid tumors metastases of the thoracic and lumbar spine

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Objective In patients with thoracolumbar spine metastases, surgery is aimed at patient healing only when patient has a good prognosis with long life expectance. In patients with short life expectancy a less aggressive surgical approach of posterior decompression and stabilization could improve patient care and allow for neurological recovery. Objective of the current paper is to analyze clinical results of this "internal bracing" surgery in patients short life expectancy and Karnofsky performance score of 50–70.
Material and methods Thirty-two consecutive patients affected by symptomatic thoracolumbar spine metastases with short life expectancy and good Karnofsky index (50–70) were subjected to surgery and reviewed retrospectively. After tumor embolization, surgery consisted of posterior decompression and stabilization with laminar hooks in the dorsal spine, and laminar hooks or lumbar pedicle screws. Patient's Karnofsky Index, average survival, Frankel neurological status, pain were recorded before and after surgery, together with surgery related complications.
Results Primary tumors were breast carcinoma (n = 9), renal cell carcinoma (n = 3), lung carcinoma (n = 4), GI tract carcinoma (n = 6), prostate carcinoma (n = 2), carcinoma of the uterus (n = 2), melanoma (n = 3), and malignant tumors at other different sites (n = 3). Average survival after surgery was 23 months, with highest survival rates in renal cancer and breast carcinoma patients, and poorest survival rates in lung carcinoma and dedifferentiated carcinoma. Karnofsky index passed from average 61% to 72% postoperatively. After surgery patients experienced significant overall improvement of Frankel score and decrease of referred pain. Hospitalization stay was on average 10 days.
Discussion and conclusions Our results showed that operative treatment of symptomatic spinal metastases in patients with poor prognosis and good general health status improves or preserves neurological function, allows for adjuvant treatments to be performed and has a role in improving general health status of life span in most patients.

En-bloc resection in primary spinal tumors

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En-bloc resection in primary spinal tumors indicates an attempt to remove the whole tumor in one piece, together with a layer of healthy tissue. Aim of this kind of surgery is to obtain the local control of the disease and to avoid the widespread metastases.
En-bloc resection is indicated in aggressive benign tumor stage 3 (obtain marginal margin is enough) and malignant tumors of the spine (wide margin is mandatory). These malignant tumors can be associated to distant metastases: in this case En-bloc resection is not the treatment of choice.
A retrospective study from 1990 to 2009 identified 140 patients affected by primary vertebral tumors submitted to en-bloc resection.

Primary spinal tumors were classified according with the oncological staging proposed by Enneking-Campanacci: 32 benign tumors stages 3, 38 malignant tumors stages IA-IB, 34 malignant tumors stages IIA-IIB. Three lesions were found in the cervical spine, 39 in the thoracic spine and 62 in the lumbar spine. In 63 patients a wide margins was achieved, in 25 a marginal margin, in 16 an intralesional margin.
All the patients were followed with an overall period of 70 months (range from 0 to 223). At a final follow-up, 71 patients were found continuous disease free (CDF, 4 to max 223 months; average: 77 months), 79 with no evidence of disease (NED 3 to 223 months; average: 75 months), 9 alive with disease (AWD 26 to 137 months; average: 84 months); 19 patients were died with disease (0 to 115 months; average 37). Twenty-two local recurrence were observed and treated (4 to 213 months; average: 71 months) in 9 surgery with intralesional margin, 4 marginal margin and 9 wide margin.
En-bloc resection can be performed in selected tumors of the spine according to the oncological staging; the procedure must be carefully planned. For this purpose, the Weinstein-Boriani-Biagini system could be a helpful tool.

METABOLIC, HAEMATOLOGIC AND INFLAMMATORY DISORDERS

Issues of prosthetic surgery in rheumatoid arthritis

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Objective The aim of this study is to investigate whether the rates of complication or survival of hip joint surgery in patient with rheumatoid arthritis (R.A.) are different compared to those with osteoarthrtis (personal experience).
Material and methods Since 1981 we performed 129 implants in 95 patients with RA. Among these we chose cementless implants in 53.4% of cases. The cemented stems were used in 46% of cases. These percentages changed in the last 10 years: now the percentage of cementless implants is more than 80%. Since 2005, we have been using neck preserving implants in most cases, few cemented (Frieldly short or CFP) and most frequently Proxima, a stemless cementless implant that can be used also in osteoporotic bone.
Results The revision's rate at medium follow-up (12 years) was 7.5% for deep infection and 6.9% for aseptic loosening. The dislocation rate was 3.5%. We had no case of letal thromboembolism.
Discussion The only significant difference that can be statically underlined between the R.A. and the O.A. (osteoarthritis) group is the rate of late infections while no significant results concerning all revisions for age, comorbidity, and cemented/uncemented prosthesis was found (according to several recent studies). In particular the osteoporosis, that could be considered as an early loosening risk factor, seems to be offset by the minor/less functional requirement. The pre-operative planning plays a very important role in RA patients (the evaluation of bone stock, the recognition of technical issues – such as protrusio-acetabuli – and the choice of the right implant are fundamental for an excellent outcome).
Conclusions The role of the surgeon is to improve functional ability for the patient by reconstructing a deteriorated joint through total joint arthroplasty. Likely, as several studies from different countries have shown, in recent years the rate of orthopaedic surgery has decreased for patients with rheumatoid arthritis (RA) thanks to the new therapies. But we have to remember that postponing THR for too long will give less functional benefit and that this is not acceptable in consideration that the overall survival of primary THAs in RA patients is similar to THA survival in OA patients.

The use of cemented and uncemented components in total knee arthroplasty in rheumatoid arthritis: mid-term results

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Young patients with a good bone stock are considered the best candidates to a Total Knee Arthroplasty (TKA) using cementless components. On the other side, cemented components are very often used in patient affected by Rheumatoid Arthritis (RA), because of the high rate of poor density and quality of the bone of these patients, due to cortisone long-lasting therapy and to the RA itself. Despite this practice, in recent literature, several Authors have demonstrated as uncemented components could be used with success in TKA even in elderly patients affected by RA [1,2]. Both the availability of more osteoconductive interfaces of new prostheses and the use of effective anti-osteoporotic drugs contribute to this new clinical trend. In this study, designed as a randomized prospective comparative trial, we evaluated the results of TKA obtained using cemented and uncemented femoral components in patients affected by RA, with a median follow-up of 3 years. We conducted a clinical and radiological study of all patients, using specific scores for knee function evaluation. The implanted prosthesis was the same in the two groups (cement and cementless), all the surgical procedures were performed by the same surgeon with the same surgical technique. The results of this study demonstrate a good clinical and radiological outcome in both groups, suggesting that the use of uncemented femoral components could be a good choice also in RA patients. We conclude that the use of cementless implants has to be carefully evaluated in TKA planning also in this class of patients.
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Alterations of the foot in sclerodermia

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We studied 30 patients suffering from sclerodermia involving the feet. From a clinical point of view, during the initial stage the foot appeared swollen as if by widespread hard podedema. Later, the subcutaneous panniculus withdrew leaving a hard cutis which was adherent to the deep layers. Arthritis which is clinically evident in the small foot joints is not frequent and prevalently involves the metatarsal-phalangeal joints. At the advanced stage, the joints of the foot are very rigid, but their conformation appears to be substantially normal, without characteristic deformations with the exception of the claw of the intermediate toes which is usually not severe. Severe

scleroatrophic lesions of the distal phalanx of the intermediate toes were also observed. No plantar trophic ulcers were found, but only hyperkeratosis due to load.
From a radiological point of view, severe apical reabsorption of the distal phalanges occurred together with slight and uncommon marginal erosion of the articular heads; the latter may be attributed to proliferative synovitis. Radiographically visible calcifications of the soft parts were sometimes present and were most frequent on the distal phalanges. Plethysmography showed a marked reduction of the blood flow in the digits affected by apical bone reabsorpion or large scleroatrophic lesions. Treatment must aim both to prevent deformities and to resolve painful symptoms, where necessary. Orthesis therapy generally provides a positive response to both these requirements. Surgery was never required due to the low incidence of deformities requiring operations in this series.

Epidemiological survey on risk factors for hip fractures: INDACO study

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Hip fracture represents the most severe complication of osteoporosis. It is related to a high impact to mortality and morbidity of aged people. A robust understanding of osteoporosis risk factors beyond low bone mineral density has led to the development of the FRACTURE index, that represents a tool identifying variables that could be easily assessed in either clinical practice or by self-administration. This model was developed and validated by Dennis Black, Olof Johnell and others in 2001, and it is a good and simple tool for the screening of risk factors among patients in the orthopaedics clinical practice allowing (even without BMD direct assessment) important insights about patient 5-years probability of hip fracture occurrence (every 2 units of FRACTURE index there is about a two fold increase of 5-years hip fracture probability).
The assessment tool, is a set of seven key parameters that can be easily asked to a patient within the usual orthopedic practice: these parameters include age, BMD T-score, fracture after age 50 years, maternal hip fracture after age 50, weight less than or equal to 57 kg, smoking status, and use of arms to stand up from a chair.
We performed an epidemiological survey (called INDACO – Indagine Centri Ortopedia) in order to evaluate the FRACTURE index among over 8589 patients recruited in 145 Italian Orthopaedics and Traumatology Departments. Among the overall recruited patients, 3589 had a recent hip fracture, 1918 subjects had lateral hip fracture (55.9%) whereas 1512 (44.1%) had medial hip fracture.
Our data show that the FRACTURE Index, either with or without BMD testing, will be useful in identifying subjects who are at high risk of hip fractures. Few risk factors independent of BMD assessment are predictive of hip fractures, supporting the assessment of fracture risk when BMD testing is not available

Total hip arthroplasty in organ transplant patients

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Osteo-articular pathology in organ transplanted patients presents as a complication of chronic organ insufficiency. The general conditions of these patients, poor bone quality and immunosuppressive therapy are risk factors for complications and failures of hip prosthetic surgery. The incidence of complications reported in literature varies widely in published series and there is still no consensus on criteria for drug treatment of these 'brittle patients'.
We retrospectively studied 18 hip arthroplasties in 15 patients who had been previously organ transplanted. All cases were studied retrospectively and the results evaluated at a mean follow-up of 3.7 years (44.5 months), maximum 9 years (109 months), minimum 4 months. Six patients underwent kidney transplant, 3 liver transplant, 1 liver and kidney synchronous transplant, 1 kidney and pancreas synchronous transplant, 1 metachronous transplant of bone marrow and lungs, bone marrow, and finally a second heart transplant. All patients upon admission to our Unit were treated with immunosuppressive drugs, in 3 cases only the drug regimen did not include corticosteroids, while the other patients were taking prednisone or methylprednisolone. Other drugs used were cyclosporine A, tacrolimus, sirolimus, everolimus, azathioprine, mycophenolic acid or mycophenolate mofetil.
One patient died after 48 h from surgery by liver failure because of liver transplant bad functioning. A patient died 2 months after surgery because of a major complication related to transplantation. In all cases, site preparation and monitoring of immunosuppressive therapies were conducted in collaboration with specialists of transplantation. The results, analyzed at a mean follow-up of 3.7 years using the Harris Hip Score, were as follows: excellent in 11 cases (73.3%), good in 2 cases (6.4%), discrete in three cases (20%), we observed no complications related to the implant and revision surgery was never carried out.
After a careful review of multidisciplinary management achieved in these patients and literature, we propose some rules concerning the management of immunosuppressive therapy and corticosteroid, antibiotic and thromboembolism prophylaxis, and techniques for anesthesia, postoperative analgesia and transfusion therapy.
The evaluation results indicate that in this series hip surgery was carachterized by a single major complication and few minor complications and good functional results. However, good functional outcome and favorable results as reported above are derived from a well-coordinated management, specialized knowledge of diseases of organ transplantation and targeted therapeutic attention. Indispensable condition despite treatment and care in dedicated environment is that the transplanted organ is in good functional status.

TISSUE ENGINEERING 2

Behaviour of bone cells with growth factors for tissue engineering applications

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Objective Whereas in muscle regeneration Fibroblast Growth Factor-6 (FGF-6) is known to play a relevant role, in bone tissue this has yet to be verified. Fibroblast growth factor receptor signaling is known to be important in the initiation and regulation of osteogenesis, so in this

study the actions of FGF-6 on human osteoblasts and osteoclasts were investigated.

Material and methods Human primary osteoblasts (hOB) were used to study the effect of FGF-6 on proliferation (by ATP quantification), signal transduction (by ERK and AKT phosphorylation), differentiation (by alkaline phosphatase activity) and mineralization (by calcein staining). To study FGF-6 activity on osteoclast differentiation, human bone marrow cells were used and tartrate-resistant acid phosphatase (TRAP) multinucleated cells together with actin filaments arrangements were quantified. Human primary mature osteoclasts were used to evaluate the effect of FGF-6 on osteoclast reabsorbing activity by reabsorbed pit measurements.

Results FGF-6 >9–10 M as FGF-2 (7–10 M) induced hOB proliferation mediated by pERK together with a reduction in alkaline phosphatase activity and reduced mineralization of the treated cells. Moreover FGF-6 increased the formation of TRAP positive multinucleated cells in a dose-dependent manner (maximal effect at 10–8 M). FGF-6 treated cells showed also a greater percentage of cells that formed typical osteoclast sealing zones. Mature osteoclasts cultured on dentine slice increased the area of reabsorption with a maximal effect of FGF-6 at 10–12 M.

Conclusions FGF-6 may be considered a regulator of bone metabolism as shown by its activity on both osteoblasts and osteoclasts in culture. In particular FGF-6 stimulates the proliferation of both cellular types and, without other cytokines, it inhibits osteoblasts differentiation and mineralization and induces bone resorption by osteoclasts.

Effects of an electromagnetic wave onto bone marrow stromal cells grown in a gelatin-based cryogel scaffold

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The modification of a gelatin-based cryogel surface plays an important role in bone tissue engineering [1]. We have followed a biomimetic strategy [2] where electromagnetically stimulated bone marrow stromal cells proliferated, differentiated, and built extracellular matrix on a gelatin-based cryogel surface. Moreover, increasing evidence suggests that an electromagnetic stimulus can modulate bone histogenesis and calcified matrix production in vitro and in vivo. Our aim was to investigate the effects of an electromagnetic wave (intensity of magnetic field, 2 mT; frequency, 75 Hz) (Igea, Carpi, Italy) on human bone marrow stromal cells in terms of proliferation, differentiation, and matrix production.

Cells were seeded onto gelatin-based cryogel surfaces, and stimulated ("electromagnetic" culture) or not ("control"). At the end of the culture period, the following parameters were studied: cell proliferation (by DNA assay), differentiation and matrix production (by ELISA assay), and matrix distribution (by confocal laser microscopy for specific bone markers, such as type-I collagen, decorin, and osteopontin).

Confocal microscope analysis revealed that the stimulation improved the distribution of differentiated cells on the gelatin surface and caused significantly higher fluorescence intensity. DNA and ELISA assays quantitatively confirmed the preceding observations.

Taken together these data seem to suggest that the physical stimulation could be used to differentiate the bone marrow stromal cells into osteoblasts and promote both cell proliferation and calcified matrix development in vitro.

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Tenocyte-seeded Artelon for management of tendon lesions: a preliminary in vitro study

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Background Management of chronic tendon ruptures is challenging for the orthopaedic surgeon. When there is a big loss of tendon substance the ruptured tendon cannot be repaired and grafting is necessary. Tendon augmentation can be provided through autografts, allografts and synthetic grafts. The aim of this study was to investigate if human tenocytes taken from ruptured quadriceps tendon could be seeded on the biodegradable PU Artelon (Artimplant, Västra Frölunda, Sweden). We analyzed scaffold colonization and collagen production after different culture periods. We aimed to better understand if tenocytes from ruptured tedons are able to colonize these biodegradable scaffolds.

Material and methods Human primary tenocyte cultures of ruptured quadriceps tendon were seeded on Artelon scaffolds. After 3, 10 and 14 days of incubation the samples were stained with Haematoxylin and Eosin and were examined under white light microscopy. Total collagen accumulation was also evaluated after 15, 30 and 45 days of culture.

Results After 14 days of culture tenocyte seeded scaffolds showed cell colonization and cell accumulation around interconnecting micropores. Tenocyte phenotype was variable. Collagen accumulation in seeded scaffolds demonstrated a progressively increase after 15, 30 and 45 days of culture, while control non seeded scaffolds show no collagen accumulation. Conclusions: In this study we demonstrated that human tenocytes from ruptured quadriceps tendon can be seeded on polycaprolactone-based PU urea scaffolds (Artelon, Artimplant) and cultured for a long period (45 days). This study also showed that human tenocytes from ruptured tendons seeded on Artelon scaffolds are able to penetrate the scaffold showing a progressively higher collagen accumulation after 15, 30 and 45 days of incubation.

ORAL COMMUNICATIONS

SHOULDER AND ELBOW 1

Long head of the biceps tendon rupture in professional wrestlers. Treatment with a mini-open tenodesis

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Introduction The aim of this study is to assess the validity of a mini-open tenodesis of the long head of the biceps tendon (LHBT) performed on 5 professional wrestlers injured while fighting.
Material and methods Five professional wrestlers with an acute rupture of the LHBT were treated with a mini-open tenodesis procedure without arthroscopic assistance. This technique is performed with two miniscule incisions of the skin. The tendon is prepared with biological fibrin glue and with a n. 2 Fiberwire; after that, the tendon is sutured to the bicipital groove with a suture anchor. At follow-up evaluation (average 7.6 years, range: 2–13), clinical assessments were obtained with the Constant Score (CS) and the Mayo Elbow Performance Score (MEPS). Forearm flexion strength was measured with a dynamometer and an MRI was also obtained.
Results At follow-up, the average age of the patients was 32.6 years (range, 28–40). The average CS of the involved shoulder was 95 points (range, 92–98), compared to 97 points (range, 94–98) of the contralateral side ($p = 0.37$). The MEPS was 99.76 for the elbow of the involved side and 99.84 for the contralateral one ($p = 0.34$). No significant difference was noted for the forearm flexion strength ($p = 0.31$).
Discussion In this study, patients were all high-demand wrestlers and biceps tenodesis was mandatory. Mini-opening without arthroscopic assistance tenodesis of the long head of the bicep tendon to the bicipital groove has been used for these professional wrestlers. Functional and cosmetic results of this technique were excellent, and they allowed athletes to return shortly to their sport activity.

Rupture of the long head biceps tendon treated with tenodesis to the coracoid process

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Introduction We evaluated at a very long-term patients with rupture of the long head biceps tendon (LHBT) in whom the tendon stump had been sutured to the coracoid tip or just laterally to the short head of the biceps tendon (Gilcreest technique). The aim was to determine the natural history of shoulders deprived of the LHBT and to assess the validity of the surgical technique.
Material and methods Between 1969–1981, 30 patients with subcutaneous rupture of the LHBT and no evidence of cuff tear underwent suture according to Gilcreest technique. The mean age of the patients was 32 years (range:20–49). Of them, 6 were professional gymnasts. The 28 patients that could be traced, were evaluated a mean of 31 years after operation.
Results The mean Constant Score (CS) was 74 in the entire group, and 86 in 22 patients. The latter patients complained occasionally of mild shoulder pain. The remaining six patients had a mean CS of 56 (range:40–81). Four patients out of the remaining 6 (aged 66 to 71 years) had clinical and MR evidence of rotator cuff tear. The other 2 underwent arthroscopic cuff repair (CS:75–81). After surgery, all professional gymnasts returned to sport activity and all the other patients again to their job.
Discussion After 30 years, the majority of the patients treated with Gilcreest operation have good functional and cosmetic outcomes. Only few patients had a cuff tear. The role of the LHBT as depressor of the humeral head is probably less important than generally thought.

SHOULDER AND ELBOW 2

The association between smoking behaviour and severity of rotator cuff tear of the shoulder

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Introduction Smoking is an important risk factor for the development of rotator cuff tears. We hypothesized smoking may influence rotator cuff tear size.
Material and methods 408 patients who underwent arthroscopic cuff tear repair were included in the study group (Cuff tears classified intraoperatively with SCOI Classification). We analysed the frequencies of smokers and the association of the amount and duration of smoke exposure with the type of tear. The average number of cigarettes per day and the total number of cigarettes in life were studied using age and gender as covariates.
Results 131 patients were smokers (32.1%), 277 (67.9%) were non smokers. There were 95 patients affected by type I tear (23.3%), 214 by type II (52.5%), 74 by type III tear (18.1%) and 25 by type IV tear (6.1%). The frequency of smokers was 23.2% (22 patients) among the type I tear patients, 33.6% (72 patients) among the type II tear, and 36.5% (27 patients) and 40% (10 patients) among the type III and IV tears, respectively. The frequency of smokers with an at least type II tear resulted 34.8% and differed significantly from the 23.2% of the type I tear patients ($p = 0.033$). Total number of cigarettes resulted significantly higher in patients with an at least type II tear ($F(1.127) = 4.694$, $p = 0.032$).
Conclusions Cigarette smoking has a correlation with sizes of rotator cuff tear. There is an increasing daily average numbers of cigarettes and a total number of cigarettes smoked in life across patients with increasing severity of tears.

Preliminary experience in the treatment of massive rotator cuff tears with a collagen scaffold

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Objective As part of the pathology of the rotator cuff, an efficient repair of tendon injury in many cases is constrained not only by the

type and size but also by the tissue quality, because a complete repair of tendon damage can be obtained although reinserted tissue can distort the proper functional recovery. The need to better resolve these situations has led to use scaffolds that have the capacity not only to fill what may be a residual tendon gap but can also be used to strengthen the tendon structure [1–3]. We therefore show our experience with the use of the Zimmer Collagen Repair Patch.

Material and methods The Zimmer Collagen Repair Patch is a biological material comprising a scaffold of acellular collagen and elastin, derived from pig skin tissue. The material is purified and processed through a patented process that makes it resistant to degradation by collagenase. The result is a strong and lasting biological system that is constantly and rapidly colonized by host tissue cells and blood vessels. The plant is supplied in the form of layers and is ideal for strengthening the large tendon repair site. The cases treated with this scaffold are over 10 with a minimum follow-up of 3 months and a maximum of 21 months. They were all clinically evaluated preoperatively and postoperatively with the Constant schedule and through the imaging with ultrasound and MRI control.

Results The results are excellent with all Constant score values above 70 points and moreover in all cases the pain is resolved.

Discussion and conclusions With our experience we can say that this collagen patch may be a very important weapon for the surgeon's shoulder in order to solve those situations where the tendon repair alone does not ensure a proper recovery of the gleno-humeral joint function.

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SHOULDER AND ELBOW 3

First episode of traumatic anterior shoulder dislocation in young patients: waiting or repairing?

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Objective The aim of this study was to prospectively assess clinical and functional results of young patients affected by a first episode of traumatic anterior shoulder dislocation treated with two different protocols.

Material and methods Between April 2006 and September 2008, 28 patients affected by a first episode of traumatic anterior shoulder dislocation were prospectively included in this study. Mean age was 22 years (range: 15–29 years). Patients were randomly included in group A (14 patients, surgical arthroscopic treatment) or in group B (14 patients, conservative treatment). All patients were followed-up at a mean of 18 months (range: 8–36 months) with physical examination and with the use of international shoulder evaluation scales.

Results At final follow-up, 12 patients of group A (86%) showed a full recovery of their pre-traumatic physical activity level, with no residual feeling of instability or pain; on the contrary, 2 patients (14%) reported a certain feeling of instability during high demand sports activity movements, however with no further episodes of instability. Range of motion of the operated shoulder was complete in all patients. In group B, 8 patients (57%) reported at least one or more episodes of anterior dislocation at follow-up, while 6 patients (43%) reported a clear feeling of apprehension during daily work and sports activity. In group A, the Rowe scale showed excellent results in 11 cases (78.5%) and good results in 3 cases (21.5%); in group B we registered poor results in 8 cases (57%), fair in 4 cases (29%) and good in 2 (14%).

Conclusions Surgical arthroscopic treatment in young active patients affected by a single episode of traumatic anterior shoulder dislocation should be seriously considered as gold standard treatment, and not simply as an over-treatment.

SHOULDER AND ELBOW 4

Lateral elbow pain. Is there anything besides lateral epicondylitis?

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Lateral elbow pain is common. The most classic diagnosis is lateral epicondilitis. This diagnosis is related to a chronic tendinosis of the extensor supinator mass. The pathologic cascade unfortunately is not completely explained. The most accredited theories correlate an ECRB tendinopathy with over-use activities such as playing tennis or an extensive use of computer mouse or keyboard typing. These scenarios are often treated with repetitive local cortisone shots or physiotherapy, with results that are not always satisfactory.

The aim of this presentation is to offer an update on the actual knowledge on the etiology of lateral elbow pain in correlation with the observations obtained during elbow arthroscopy and the use of clinical tests.

At least 3 different scenarios causing lateral elbow pain are recognizable:

1. Classic over-use pathology that causes a stretching of lateral tissues (Lateral capsule and origin of the extensor radialis carpi brevis and longus). The origin is a microtrauma with repetitive repairing failures with progressive apposition of inflammatory material. The clinical examination is positive for an elective pain on the lateral epicondyle, together with a positive wrist extension resisted test and a positive resisted supination test. Unfortunately, both ultrasound and MRI are unspecific. More informations could be obtained with specific T2 weighted sequences with the elbow in flexion.
2. A microinstability pattern of the posterolateral compartment due to repetitive valgus stresses like manual workers that hold heavy weights all day long. These patients sometimes presents an elongation/insufficiency of U-LCL with progressive subluxation of the radial head. Posterolateral pivot shift test and posteolateral drawer test most of the times present a weak positiveness. During surgery it is possible to plicate/retension the U-LCL.
3. A presence of synovial material or plicae in the posterolateral compartment (already described in 2 different variances). The clinical tests for stability are negative and pain is mainly localized at the level of radiocapitellar joint.

In our experience most of the times these patterns are overlapping. This is the reason for which we prefer to address these scenarios arthroscopically, as all minor features are amplified and more clearly defined.

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Long term results of the resection of the radial head

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Objective The fracture of the radial head is the more frequent traumatic lesion in the elbow. Resection of the radial head has been the election treatment, whereas the osteosynthesis was not possible, up to the realization of the prostheses of the radial head.

Material and methods Nowadays, in literature, the demand of the prostheses is justified by the finality to reduce the percentage of the possible complications related to the resection of the radial head: postero-lateral instability in case of concomitant lesion of the lateral collateral ligament, valgus instability in case of concomitant lesion of the medial collateral ligament, longitudinal instability in case of concomitant lesion of the interosseous membrane (Essex-Lopresti), ulno-humeral arthrosis caused by overload.

Discussion and conclusions With this job we wish to expose our considerations on the revision of our case histories of resections of the radial head, with a 5-year minimum follow-up a 10-year middle follow-up finalized to the observation of the long term results on the elbow's joint and on the radio-ulnar distal joint.

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Middle-term results of surgical treatment in complex elbow instability: a prospective study in 47 cases

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Objective Complex elbow instability (CEI) consists of osteo-articular fractures associated with capsule-ligaments tears and muscle-tendinous lesions causing a loss of elbow stability. The surgical treatment of CEI is one of the most challenging in traumatic conditions. Recent investigations reported unsatisfactory results in 30%–40% of cases. The aim of our study was to evaluate if the application of current treatment protocols can improve CEI results.

Material and methods From 2005 to 2009, 47 patients, with a mean age of 53 years, were studied prospectively. Five patients had a radial head fracture associated with elbow dislocation or MCL tear, 11 had a terrible triad, 2 had an anteromedial coronoid fracture associated with elbow dislocation or LCL tear, 20 had a complex fracture-dislocation of the proximal ulna and radius, 9 had a capitulum humeri and trochlea fracture associated with elbow dislocation or MCL tear. The proximal ulna was fixed with posterior precontured plate or tension band wiring; the radial head was repaired with precontured plate or headless screws. In Mason III fractures the radial head was always replaced. The coronoid fractures was fixed in all cases with trans-osseous suture, wiring, or precontured plate. The LCL was reattached with suture anchors or trans-osseous suture. If the elbow remained unstable, MCL was repaired and/or an hinged external fixator was applied. Indomethacin (100 mg/daily) was administered for 5 weeks to prevent heterotopic ossifications (HO). At the third postoperative day, all patients start active and passive self-assisted ROM. The patients were examined every 3 weeks in the first 3 months and every 3 months in the first year. After 1 year the evaluation was done every 12 months. The results were evaluated with MEPS.

Results Results were excellent in 29 patients, good in 10, fair in 3 and poor in 5. The patients with an excellent or good results recovered functional R.O.M. between the third and ninth week. At final follow-up 2 patients had a proximal radio-ulnar synostosis, 1 patient had a persistent instability and 2 patients had an elbow stiffness associated with HO. We observed 11 cases of HO (6 asymptomatic); in 5 of them Indomethacin was interrupted in advance. The reoperation rate was 11%.

Conclusions Complex elbow instability is a challenging injury even for expert elbow surgeons. Our experience shows that a definite treatment protocol may improve clinical results.

Short and middle term results of the lateral resurfacing elbow (LRE): a prospective multicentric study

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Objective Pooley recently developed the hemilateral and the lateral resurfacing elbow (LRE) procedure for the treatment of osteoarthritis or early rheumatoid arthritis primarily affecting the radiocapitellar joint. The need of a prosthesis that exclusively replaces the lateral compartment arises from cadaveric and clinical studies showing an early and elective involvement of the radio-humeral joint. In presence of marked lateral ostheoarthitis, total elbow arthroplasty (TEA) still represents the only effective treatment to obtain pain relief. However TEA has limited indication in young patients and when the ulnohumeral joint is preserved. The LRE shows several possible advantages: (1) pain relief; (2) maintenance of loading force balance among compartments (to avoid the ulno-humeral overload secondary to radial head excision); (3) bone-stock preserving technique. The aim of our study was to evaluate the preliminary results of LRE.

Material and methods 12 patients with a mean age of 53 years underwent surgery for stiff and painful elbow. 6 patients, had primitive osteoarthritis, 5 patients had post traumatic osteoarthritis and 1 patients had rheumatoid arthritis. Ulno-humeral arthroplasty and LRE were performed in all patients. In two cases the radial component has not been applied (hemy-LRE). At the third postoperative day, all patients started

active and passive self-assisted ROM. Indomethacin (100 mg/daily) was administered for 5 weeks to prevent heterotopic ossifications (HO). The patients were examined every 3 weeks in the first 3 months and every 3 months in the first year. After 1 year the evaluation was done every 12 months. The results were evaluated with MEPS.

Results The mean follow-up was 2.1 years (6–40 months). The results were excellent in the 84% of the patients, good in 8% and poor in 8%. In the patient with poor results radiograph showed a posterior HO and the clinical evaluation demonstrated elbow stiffness. At final evaluation no patient complained pain with the exception of two. The first patient complained a moderate discomfort during physical exercises, the latter developed an ulnar nerve neuropathy. All but one recovered normal elbow stability. All patients were satisfied of clinical results and returned to previous activity level.

Conclusions This study underlined good short and middle term results of LRE, with painless functional recovery of the elbow in over 80% of the patients. We believe that the future development of LRE will allow to extend its indications and to reduce TEA in young patients.

Use of 70° scope in elbow arthroscopy: the over the corner vision

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Arthroscopy is definitively gaining a primary role to face recurrences of lateral epicondilytis. Elbow arthroscopy allows the surgeon to work both in the anterior and posterior compartments as well as to treat the associated pathologies as chondropaties, articular wear and synovitis. Unfortunately, the dedicated international literature is poor. In particular, the risks to cause damages to the lateral collateral ligaments in its posterior band with the risks of a secondary instability limit the surgeon to perform an adequate release of the ECRB tendon, with an higher failure rate.

Technical papers generally indicate to look at the ecrb tendon with the scope inserted from standard or proximal anteromedial portals while the resection is performed from proximal anterolateral. Unfortunately, with a 30° scope is almost impossible to completely visualize the capitulum humeri in its more posterolateral component. These same works mainly suggest to resect till the half of the capitulum humeri, in order to not to risk a damage of the ligament.

With our work we would like to show how a safe use of the 70° scope allows a vision over the corner and a clear exposure of the LCL and resection of all the inflammatory tissue.

How to safely approach the anterior portals in elbow arthroscopy

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Elbow arthroscopy is a complex procedure due to the close vicinity of nerves and vessels to the joint. Just considering the anterior compartment, the posterior interosseous nerve runs few millimetres in front of the radial head.

As a correct sequence to improve the safety of working in the anterior compartment a quite popular technique has been popularized by Dr. O' Driscoll with the use of capsular retractors through the proximal anterolateral and anteromedial portals.

We suggest 2 further techniques, in particular during the early establishment of anterior/lateral portals.

The first one consists in a retraction band passed from the anteromedial to the anterolateral portals. Once in tension this band retracts before the structures at risk.

The second technique consists in a protection of the anterolateral compartment and the retraction of the anterior capsule with mechanical distraction from the posterior portal. Either a Small foley catheter or a bending retractor are inserted from soft spot (posterolateral) portal and passed laterally to the capitulum (between the LCL and the capitulum) during posterior arthroscopy. In this way the anterior capsule is distracted manually improving the safety to work in the anterior compartment.

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HIP 1

Treatment of advanced femoral head avascular necrosis with Birmingham mid head resection (B.M.H.R.) arthroplasty

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Resurfacing replacement represents the most conservative solution available for total arthroplasty of the hip. Its extreme preservation makes this implant definitely indicated for young and active people, saving most of bone stock for future revisions and conceding a functional joint restoration similar to physiologic range. However, these implants are not suggested in advanced femoral head avascular necrosis, in which generally the main surgeon's choice is more oriented to conventional total hip arthroplasty. Actually even in these femoral head deseases, preservation of bone stock is still available, by using a cementless resurfacing arthroplasty (BMHR) that provide a mid femoral head resection, with positioning of a press-fit stem (in the head-neck junction) on which femoral head component is applied.

We are performing these implants since January 2007. Young age (included between 30 and 60 years), advanced avascular necrosis of femoral head (Steimberg III and IV) have been considered as indication for this implants. Each of them has been implanted using a posterolateral approach performed always by the same surgeon. Clinical evalutation has been based upon Harris Hip Score (HHS) pre-operatively and post-operatively, radiographics findings (radiolucency, osteolysis, bone thickening, femoral notching) have been analyzed and registered on the basis of Gruen scheme, while implant orientation of femoral components has been related to neck inclination (varus/valgus). Post-operative HHS1 for the whole cohort was 77.8 in the first month, 94 in third month, Implant orientation has shown a proper positioning defined as a variation from physiologic axis in AP included between $\pm$ 5 degrees, the most of the implants shown a valgus

orientation (mean 6.4°, range 6–8°). Radiographic evaluation in accordance to Gruen2 method has shown in all cases the absence of radiolucency.
The mid head resection resurfacing arthroplasty (BMHR) can be considered an efficient alternative to conventional hip arthroplasty in advanced avascular necrosis of femoral head (Steimberg III or more). It represents the less invasive femoral solution available for primary procedures in these femoral deseases, saving most of bone stock for future revisions and conceding a functional joint restoration that falls within physiological range as for conventional resurfacing.

Analysis of failures in the use of trabecular metal rods in avascular necrosis of the hip

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Objective Recently, the use of rods made of trabecular metal with porosity and stiffness similar to cancellous bone has been proposed for the treatment of Avascular Necrosis (AVN) of the hip to allow a mechanical support to the necrotic bone and to stimulate the production of new bone. Objective of the current study is to review our experience with the use of trabecular metal rods in AVN of the hip.
Material and methods Between 2005 and 2007, 5 male patients were implanted with tantalum rod (6 hips), (average age 53 years) for AVN of the hip: etiology was unknown (n = 2), due to corticosteroid chronic use (n = 2), and consequence of chemotherapy (n = 1). In all cases the implant of the rod has been associated to autologous platelet-derived rich fibrin. In 5 cases, Steinberg grade was between 1 and 2, in one patient was grade 3. Average follow-up was 2–4 years (average 2.5 years). Patients were studied with preoperative MRI and X-rays, and with postoperative radiographs, with Harris Hip Score before surgery and one year thereafter. The explanted rod and the surrounding bone was studied by histological examination.
Results Of the five patients, one recovered from the process of necrosis and showed revascularization of the head with the presence of new-formed bone. In 4 patients (5 hips), necrosis evolved independently and we observed implant failure requiring arthroplasty. Average preoperative Harris Hip Score was 41.01, while one year postoperative value was 57.3. In 2 patients, the tip of the rod protruded into the hip point for the collapse and reabsorbed necrotic bone. In one patient, the weakening of the trocantheric region during arthroplasty surgery determined the fracture of the great trochanter requiring wiring.
Discussion and conclusions In our experience, the implant of a biocompatible rod able to stimulate the formation of new bone and promoting vascularization by sustaining the collapsing femoral head was not associated to encouraging results. Moreover, the presence of the device can complicate hip arthroplasty surgery. Histological examination has confirmed the ability of the trabecular metal in osteconduction of new bone.

HIP 2

Total hip replacement performed with the minimally invasive direct anterior approach

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Minimally invasive surgery (MIS) is a surgical technique that utilizes a small skin incision, thus avoiding muscular and tendon damage.
In a total hip replacement, minimally invasive surgery has the following advantages compared to traditional surgery: the reduction of haematic loss; the reduction of post-operative pain, resulting in both quicker post-operative recovery and shorter overall recovery periods in hospital. The Direct Anterior Approach to the hip, first introduced by Judet in 1947 as a modification of the Smith-Petersen approach, operates according to the MIS principles [1].
From December 2007 to December 2009, 331 patients underwent minimally invasive total hip replacement surgery with the direct anterior approach. The sex ratio was 146 males to 185 females. The average age was 70 years (min 30–max 87). Nine patients were operated on both hips. Thirteen patients were carriers of a contralateral prosthesis which had been implanted through a lateral approach.
All patients were available for a follow-up. Complications typically resulting from the anterior approach (pertrochanteric fractures, diaphyseal fractures, injury to the lateral femoral cutaneous nerves) and those typically resulting from any hip replacement (dislocations, DVP) did not occur. A superficial surgical site infection occurred in one case and was treated by draining the wound and the appropriate antibiotic therapy. The operation time, after the due learning curve, was comparable to that necessary for the lateral approach initially used. In all cases, both objectively and subjectively, hospital stay, haematic loss, pain, recovery time required for resuming normal activities, were reduced whilst the satisfaction of the patient increased compared to our previous experience with the classical lateral approach.
In authors' opinion and in recent reports in literature [2, 3], the Direct Anterior Approach to the hip is by far the safest technique to protect the tissues. It can be performed by a specialist hip surgeon after the normal training in minimally invasive surgery, with great satisfaction of the patient.
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The Ganz Periacetabular Osteotomy. First six years experience

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Introduction The Ganz Periacetabular Osteotomy is a validated procedure for the treatment of the early degenerative stages in hip dysplasia. We present our results after the first six years of experience with this surgical procedure.
Material and methods One series of 54 patients (42 women) with a mean age of 27 years (19–45) treated by means of Ganz Periacetabular Osteotomy and evaluated at a mean follow-up of 48 months (12–68). We evaluated pre-operatively and post-operatively:

- Wiberg's CE angle in AP and Lateral view on plain X-ray;
- Acetabular Index;
- Intra operative bleeding;
- Need for post-operative blood transfusion;

– Surgical time;
– WOMAC and Merle d'Aubigne scores.

Results The mean Wiberg's CE Angle improvement was 19.5 degrees (15–38) in AP view and 22 degrees (10–45) in Lateral view, with a mean post-operative value of 32.5 and 35.10 degrees respectively. The mean Acetabular Index improvement was 6 degrees (2–13) with a mean value of 28 degrees (22–38). The mean WOMAC Score improved from a pre-operative value of 47.3 to a post-operative value of 92.7. The mean Merle d'Aubigne Score improved from a pre-operative value of 14.6 to a post-operative value of 17.1. We had 19 cases of transient neuroapraxia of the LCFN, one case of transient paresia of the sciatic nerve, 2 cases of delayed bone union at isquion cut. One case of post-operative anterior acetabular overcoverage required a mini open anterior acetabuloplasty. None of the cases required a THR.
Conclusions Even if we present early and mid-term results, the Ganz Periacetabular Osteotomy showed good results in our series, according to other published studies with a similar follow-up.

From the resurfacing to the hemicephalic hip: evolution of the concept of bone sparing with a new prosthetic design

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Despite resurfacing prostheses present excellent clinical results at the middle-long follow-up, these implants begin to present a percentage of complications amounting in some cases to 10%.
The causes depend by phenomenon of cephalic necrosis resulting in fractures of the neck or in the early sinking of the implant or backward mobilization.
These aspect suggested the development of a prosthesis with a preservation of the femoral neck, avoiding the risk of cephalic necrosis.
Hemicefalic prosthesis MRS-Plus (Lima Lto, San Daniele del Firuli, Udine) has a finned titanium stem with sand-blasted surface, with four lengths and two diameters (17 and 19 mm) and the possibility of assembler stem-head with a concentric or eccentric adaptor in two lengths (Standard and Long).
The characteristics of the implant are: (a) the possibility of avoiding the collapse of the head in case of necrosis through the resection of polar superior part; (b) the possibility of reducing the incidence of neck fractures through the osteointegration of the stem that becomes load-bearing and a support for the cephalic part; (c) the possibility of stimulating the bone with compression forces and not cutting forces through the position of the femoral stem along the natural axis of the neck, with the opportunity of centring the head by eccentric adaptor avoiding "notching".
We evaluated 24 primary implants in 22 patients (20 men, 2 women, 2 bilateral implants) operated from January 2008 to September 2009. The average age was 52 years, the diagnosis was primary osteoarthritis of the hip in 22 cases, cephalic necrosis in 2 cases. The average follow-up was 12 months.
Clinical results through the average Harris Hip Score at final follow-up were excellent (average 96.7). In 3 cases there was a radiolucent line in the inferior part of the stem (zone 1), less than 2 mm and stable at the follow-up.
There were no signs of loosening of the implant or alteration of cervical-diaphyseal angle.
Although the follow-up is short, hemicefalic MRS-Plus implant showed promising results.

External snapping hip syndrome: results of endoscopic iliotibial band release

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Objective Snapping hip syndrome is a complex symptom described as an audible or palpable snap of variable intensity occurring around the region of the hip during motion or walking. The external snapping hip is the most frequently encountered type caused by slippage of either a thickened iliotibial band or a focal thickening of the anterior edge of the gluteus maximus muscle over the greater trochanter during motion. Several open surgical techniques have been used to treat this condition in the cases recalcitrant to nonoperative treatments. More recently, endoscopic techniques have become available to address this problem. The purpose of this study was to investigate the results of the endoscopic release of the iliotibial band.
Material and methods 19 patients (4 male and 15 female) with recalcitrant external snapping hip were treated with endoscopic release of iliotibial band between January 2003 and March 2009 at San Salvatore Hospital in Pesaro and Villa Maria Cecilia Clinic in Cotignola. The average age was 25 years (range: 13–37 years). The procedure was performed in the lateral decubitus position using 2 portals, the iliotibial band was released using a RF hook probe. The patients were evaluated by clinical examination and investigated about their satisfaction and their return to previous level of activity.
Results At an average 2-year follow-up all patients had no complaints and returned to their previous level of activity.
Conclusions The endoscopic release of iliotibial band is a safe and reproducible technique with excellent result in term of symptoms resolution, patients satisfaction and return to previous level of activity.
Level of evidence: consecutive case series, Level IV

HIP 3

Hip arthroplasty in Paget's disease: retrospective analysis of outcomes at 5.4-year follow-up

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Introduction Paget's disease (PD) is a rare disorder of bone characterized by increased resorption and formation of bone, with monostotic and polyostotic patterns, frequent in upper femur and pelvic bone. Performing hip prosthesis in this condition may potentially lead to an increased risk of complications, with reduction of implant survival rate [1]. We performed a retrospective analysis on patients with pagetic hips who were treated at our institute with cementless hip arthroplasty for arthritis.

Material and methods From 1988 to 2009, 24 patients with PD (15 male, 9 female; 1 bilateral; average age: 69.3 years) were identified on a total of 10,904 primary hip arthroplasties performed at our hospital (0.2%). In 15 cases a cementless prosthesis was used, in 9 cases a partially or totally cemented prosthesis was implanted, in 1 case a mega-prosthesis was used in a patient with associated upper femur fracture. All patients underwent a clinical and radiographic evaluation by independent observers.
Results Mean follow-up was 5.4 years (range 1.3–11 years). Two complications (8%) were observed: 1 ceramic head fracture treated with partial revision and 1 peri-prostethic fracture treated with plate and cables. No cases of cup or stem substitution; mean WOMAC score improved from 53 to 91.1, with 90% of good or excellent results (WOMAC >80).
Discussion Hip arthroplasty is a safe procedure that allows good functional outcomes and improvement of quality of life also in patients with PD and hip arthritis. Complications' rate is high although the mid-term implant survival is not significantly elevated if compared to hip arthroplasties performed for other indications. No significant differences were observed between cemented and cementless implants. Therefore we suggest to use cementless implants whose survival is known to be higher [2]. Care must be taken in the accurate positioning of prosthetic components and prevention of heterotopic bone formation.
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Leg length and offset measure during total hip arthroplasty

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Nowadays the large diffusion of hip replacement surgery, the extension of the indications to younger people with high functional demands and the new wave of legal problems make the leg length discrepancy and offset control a critical feature in hip arthroplasty.
It is presented a new calliper called hip ruler and a study that compares it with other common methods to control leg length during surgery.
Eighty patients were randomised and compared. They have been all treated by two surgeons (AN and AM) with postero-lateral approach. In 40 cases the hip ruler has been used, in 40 ones other methods. Exclusion criteria were displastic hip (Crowe III and IV), ankylosis, post traumatic arthritis, flexed hips or knees, revision surgery.
The leg length discrepancy before and after the surgical replacement was measured on the radiographic AP view of the pelvis, corrected by the scale of magnification. These data have been then compared with the measures recorded during surgery by the hip ruler or the other methods in order to obtain the gap between the intraoperative values and the real leg lengthening or shortening of the limb. This way we checked the accuracy and so the utility of the calliper. The operative time was considered too.
The results show a significant superior accuracy of the hip ruler compared to the other methods while the difference of the operative time between the two groups was not statistically significant.
The hip ruler can be a useful device for all hip surgeons since leg length discrepancy and offset can be easily, effectively and cheaply measured.

Celecoxib is effective and well tolerated for the prevention of heterotopic ossifications following total hip arthroplasty: an observational, prospective, multicenter Italian study

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Objective More than 50,000 total hip replacement (THR) are performed each year in Italy and approximately one million worldwide. Among the complications that can be prevented, there are heterotopic peri-articular ossifications (HPO). In the absence of an adequate prophylaxis, HPO are clinically relevant in about 5% of the patients that undego THR, with reduced range of motion, ankylosis and, sometimes, pain. Randomized studies have shown the better efficacy and/or tolerability of pharmacological prophylaxis of HPO after THR with the use of celecoxib, a selective COX-2 inhibitor, compared to other less selective anti-inflammatory non steroideal drugs. Aim of the present study has been to evaluate the efficacy and tolerability of HPO prophylaxis with celecoxib after THR, in General Hospitals of two Italian regions.
Material and methods This prospective, observational, multicenter study has been performed in 5 Departments of Orthopaedics and Traumatology in the Abruzzo and Molise Regions, on a total of 226 patients, operated for THR in the year 2008. Pre-operative diagnosis, surgical approach, pre- and post-operative Harris Hip Score, associated co-morbidities, type of prophylaxis (celecoxib 200 mgx2 die for 15–20 days *vs.* no treatment), side effects, HPO according to the Brooker classification were registered.
Results On 226 patients, 184 have treated with celecoxib and 42 have not been treated, mostly for cardiological contraindications. Grade 1, 2, 3 and 4 ossifications have been observed, respectively in 10 (24%), 9 (21%), 3 (7%), 1 (2%) of the untreated patients and in 35 (19%) and 7 (4%) of the patients treated with celecoxib (see Fig. 1). The difference of the overall incidence of HPO in the treated versus untreated patients (23% *vs.* 55%) is extremely significant ($p = 0.0001$, Fisher's

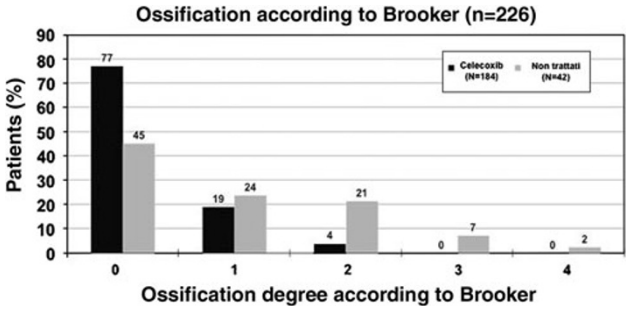

Fig. 1

exact test). Only 6 (3.5%) patients in the treated group did report minor gastrointestinal side effects.
Discussion and conclusions Celecoxib for the prophylaxis of HPO after THR has been shown to be effective and well tolerated in the general clinical practice.

HIP 4

Delta Revision system in hip surgery: our experience

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Introduction In this report we show the preliminary results of our experience with the Delta Revision system in hip surgery.
Material and methods We gathered data concerning all patients who underwent a hip-prosthetic surgery with the Delta Revision system, from January 2008 till January 2010.
Results The study encompasses 48 patients. Forty cases presented aseptic mobilisations of first implants, while in 8 cases we chose the Delta Revision system as a first implant, because of peculiar anatomic/morphologic acetabular peculiarities. In particular, we were dealing with 1 megacotyle, 1 pseudo-osteoarthritis of the cotyle's bottom, and 6 consequences of acetabular fractures. The average follow-up was 1.1 years after the surgery. The Harris hip score shifted from an average pre-surgical value of 37 pts to an average value of 88 pts during the follow-up. During the follow-up, all components were considered stable and we did not notice any case of periacetabular or femoral osteolytic lesions, due to osseous reabsorption, resulting from osseous usury detritus.
Conclusions The results of our mid-term study are encouraging and draw attention to the great effectiveness and validity of this kind of cotyle prosthetic component. The large diameter geometry – both equatorial and of the tutorial applicable heads – grant a greater stability and an ample articularity of the implant. Finally, the trabecular titanium structure grants a valid and widespread osteointegration.
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Bicon cup revisions of G.I.R. stages I-II loosening

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Background The double conicity in the prothesis design is the main feature of the new standard and porous Bicon cup, and it represents and improvement which allows the application of such prothesis even in a damaged bone or in case of surgical revision. The strong hold of about 2/3 of the thread has shown to be enough to ensure a stable primary anchorage. The Bicon cup is made of titanium with a micro-rough surface. In the bottom of the cup there are three lamellae, through which it is possible to see the acetabulum and eventually to insert bone-grafts, which will firmly stay in seat after the closure of the bottom itself.
Material and methods After a wide experience in the early implants, we have been using the Bicon cup even in the stages I-II cup loosening since 2002. At these stages the main problem is not much to fill up the bone lack, but to obtain a firm and immediate anchorage, by correctly placing the new prothesis (i.e. with the most correct centre of rotation and avoiding the climb and verticalization as well as the retroversion of the cup itself). This study includes 60 revisions performed since January 2002 to January 2008, with a follow up period of 2 to 6 years.
Results From the clinical point of view, the Harris Hip Score passed from 55 (pre-surgery) to 88 (post-surgery). Among the complications we observed one dislocation, one infection of the prothesis and two cases of TVP. Radiographic evaluation of the position of the centre of rotation showed a mean pre-surgery climb up of 1.2 cm, then reduced to a mean value of 0.8 cm in the post-surgery controls.
Conclusions The good results that can be achieved nowadays with this type of Biconical Cups are very different compared to the poor results that have been obtained in the past with the conical or frusto-conical cups, due to some basic differences: (a) the biconical shape which contrasts medial migration; (b) the microporous titanium surface which provides a better osteointegration compared to smoother surfaces; (c) the great extension of the threaded surface which allows for an effective primary and secondary stability; (d) the closable apex sectors to prevent bone contact with the PE insert.
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TRAUMATOLOGY 6

The Vivostat system for prevention of bleeding in pelvic fractures surgery

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Introduction The system Vivostat is a procedure that gets fibrin glue from 120 cc of processed blood from the patient. In literature there is no documentation showing the use of this system in pelvic and acetabular fractures surgery.
Objective The purpose of this study was to evaluate the reduction of bleeding source in fractures of the pelvis and acetabulum, after use of fibrin glue.
Material and methods The system was used for each type of injury concerning the pelvic ring or the acetabulum. The fibrin glue is sprayed with a spry-pen immediately after obtaining the reduction of the fracture. It is also used before the suture in sub-cutaneous fat. 120 cc of blood from the system gets 6 cc of fibrin glue and allows

continue application up to 6 min. The system also allows intermittent use up to 8 h. It is very safe because it avoid the risk of viral infection or autoimmune response and blood sampling can be obtained in any patient even if suffering from bleeding disorders or under treatment with heparin or aspirin.
Results Patients were evaluated intraoperatively, recording the sharp reduction in both bone and subcutaneous bleeding (especially if the fat was well represented), compared to cases where it was not used. In the immediate post-operative, the surgical wound and the dressing that was much drier were evaluated. We also evaluated drainage, by quantitative and qualitative measurement, and Hb consumption, and finally the amount of bags of blood transfused in the first 24 h and Hb values before and after surgery.
Conclusions In our experience over the use of Vivostat, initial results are encouraging. The bleeding seems to be reduced and savings in terms of blood bags and consumption of Hb appear to be valid.

Diaphyseal femoral fractures in adolescents under 18

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Introduction The treatment of adult's femoral shaft fractures is surgical and generally intramedullary interlocking nailing is the best solution. For the same fractures in children and boys under 14 years of age, bloodless or mini invasive techniques are indicated (close reduction and plaster, intramedullary elastic nailing, external fixation). Problems can arise around the best treatment in adolescents and young adults. We present a retrospective study of two homogeneous groups of teenager affected by diaphyseal fracture of the femur treated with two different methods.
Material and methods The study includes 30 closed femoral shaft fractures, in patients aged 14–18: 15 cases treated with interlocking intramedullary nail and 15 with unilateral external fixator. With these two techniques an open reduction was never required and a partial weight-bearing was allowed since the first week. Dynamization of external fixator or removal of the nail's distal screw was performed after eight weeks. Full weight-bearing in nailing was allowed after three weeks and after two months in external fixation.
Results All the fractures consolidated. The nails were removed after a mean of 8 months and external fixators in 4 months. A blood transfusion was necessary in two patients after intramedull-ry nailing. Antithrombotic prophylaxis was performed in all the nailings. Pin's infection required antibiotic therapy in 12 cases and 1 case needed an early removal of the external fixator. One delayed union and 4 displacements occurred among the cases treated with external fixator.
Conclusions The consolidation was always achieved with both techniques. In our opinion in the period between 14–15 and 18 years of age intramedullary nailing seems to be more tolerated respect to the external fixation. Size of the patients, their physical structure and the development of thigh's muscle, predispose to recurrent and surface infections of fixator's pins, to axial deviation and to more prolonged periods of treatment compared to younger patients. Disadvantages of nailing are the longest surgical time, greater exposure to X-ray and the need of antithrombotic prophylaxis. Last generation's nails, with thinner diameter, that requires less reaming, reduces bleeding and blood transfusions. For these reasons we are more often led to this surgical choice.

Treatment of distal femur fractures using polyaxial locking plate

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Designs and technique of locked-plate for treatment of challenging fracture continue to evolve. Polyaxial locked plate has the ability to angle a screw enhancing the possibility of fracture fixation. The purpose of this study was to evaluate clinical and radiographic results with the use of polyaxial plate for treatment of distal femur fractures in our Institution. Between June 2006 and December 2008, 56 patients with 57 fractures of the distal femur were treated with open reduction and internal fixation with a polyaxial locking plate (POLYAX plate, DePuy, Warsaw, Indiana). There were 21 male and 35 female, mean age was 63.8 years. Forty-four fractures were closed and thirteen open. Twelve patients were lost to follow-up prior to fracture union, and four patients died within one month after surgery, three of them for multi-organ failure. The mean follow-up in the 40 patients (41 fractures) was 51.4 weeks (range, 24 to 116 weeks). At last follow-up 38 of 41 (92.7%) fractures were healed. One polyaxial screw backing out with no consequent wrong alignment or plate failure was reported. The mean Knee Society knee score at the time of follow-up was 87.8 points (range, 9 to 100 points), and the mean Knee Society function score was 73.4 points (range, 0 to 100 points). No deep infection was developed in our series. High fracture healing rate and clinical results reported in our series shows the versatility and the effectiveness of POLYAX plate in treatment of complex distal femur fracture without wrong alignment and mechanical failure.

TRAUMATOLOGY 7

DBM for the treatment of comminuted fractures and non-union

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Metaphyseal and diaphyseal high comminution fractures with bone loosening and non-union are often difficult solution problems.
Treatment of these lesions is a hard challenge because of technical difficulties of surgical procedures, long rehabilitation time and social costs too.
These bone lesions often require both stability and biologic stimulation to heal. For this reason scientists and surgeons are recently interested in the development of new graft materials complementary to autologous bone transplant, to reduce morbidity and complications of harvest patient's site.
We report the results of our experience using the DBM (allogeneic demineralized bone matrix) in non-unions, tibial plateau fractures, distal high comminution femoral fractures, ankle fractures and hip revision surgery.

The treatment of upper limb nonunions using mesenchymal stem cells expanded in laboratory: first experience

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Objective Stem cells, unspecialized cells that renew themselves through cell division for an indefinite period of time which may develop into specialized cells of various tissues, have seen increasing interest in orthopaedics due to the fact that the mensenchimal line, which is multipotent, can lead to differentiation into osteocytes and with the formation of bone [1]. Applications are described in the literature for tendons and ligaments injuries, small bone avulsions, nonconsolidated fractures and nonunions and cartilage lesions [2]. Thanks to a Ministerial exemption, in our clinic, using these cells expanded in laboratory has been possible from July 2004 to December 2007. With the collaboration of the U.O. Hematology of Pisa we get the quantity cell to be implanted through a procedure that involves the removal of bone marrow from the iliac crest and the next phase of selection and cultivation of mesenchymal line for 3 weeks to obtain sufficient amounts of tissue to be used, which is presented at the surgery act on a scaffold, well manipulated, of autologous plasma jelly and $CaCl_2$ [3].
Material and methods One of the various application fields for these cells is certainly delayed consolidation and pseudoarthrosis and in this study, we reassessed our experience in 8 different types of upper limb fractures resulted in non-union. We enrolled 5 female and 3 male with a mean age of 48.5 years. In all cases the site of nonunion was reclaimed and a synthesis was performed with rigid plate and grafting with mesenchymal stem cells and autologous bone.
Results In 7 cases we obtained a complete clinical and radiographic healing in a mean time of 6 months. In 1 case of avital/avascular pseudoarthrosis we did not get a bone healing.
Discussion and conclusions Using this cell line expanded in laboratory we obtained encouraging impressions but certainly not conclusive, according to the limited number of cases and the lack of adequate comparative studies. Further investigation and development in the field of tissue engineering are certainly required.
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DIF system, dynamic internal fixer: illusion or reality?

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We herewith show the results obtained in diaphyseal as well as distal and proximal epiphyso-metaphyseal femoral fracture treatment by means of the DIF innovative system. Such system belongs to the so-called "internal fixers" category, i.e. angular stability plates which have been modified so as to become dynamic, when required. Within the action limit of the external fixers, this system, therefore, allows modulating the need to increase focus compression when charging during the healing process. Furthermore, the possibility of a plate-sliding system discharges the angular flexion pressure (flexing movement) becoming a sliding movement and thus an axial compression. The biomechanics osteo-implant system theory is discussed and the clinical and radiographic results obtained in fractures and pseudoarthrosis treatment are shown.

TRAUMATOLOGY 8

External fixation in calcaneal fractures, a preliminary study for a new treatment

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Surgical treatment of calcaneal fractures still represents a challenge for orthopaedics surgeons. Even if it is often necessary to obtain a good functional restoration of the foot and ankle, osteosynthesis with plate and screw often causes a high complications rate, such as wound dehiscence, skin necrosis and soft tissues infections. An alternative to internal fixation has always been external fixation with K wires and screws normally used in patients with risk factors as diabetes, oedema and skin lesions, and fracture exposure, but this kind of treatment does not avoid a good control of the fracture and an early articular mobilization. The use of external fixation in calcaneal fractures has been possible till now only using complex and not dedicated assembly.
Since June 2009 in our Operative Unit we have started to use for displaced calcaneal fractures the external Orthofix fixator dedicated to calcaneal fractures and we carried out a retrospective review of 5 patients aged on average 56.2 years (range, 36–73 years). The fractures were evaluated preoperatively by plain radiographs and a CT scan. Using Sanders' classification, one fracture was type 3 ABC, one fracture type 3 AB, two type 2B and one type 1 A. The average time to surgery was 5 days from the fracture (range, 2–9 days). Patients never had a cast and started immediately ankle mobilization. A partial weight bearing was avoided within 50 days and a complete weight bearing within 60 days. The external fixator was removed after 70 days.
None of the patients had soft tissues complications, not even infections. Radiological post-operative evaluation showed a good restoration of bone architecture. Clinical assessment calculated with the American Orthopaedic Foot and Ankle Society Score (AOFAS) was 85 (98–75) at the last control.
Obviously it is necessary to enlarge the series of patients, but the results obtained in this preliminary study are extremely encouraging both for the poor soft tissue mortification avoiding a reduction of possible complications and for the very good functional results.

Biodegradable plates and screws in ankle fractures

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Introduction A common problem following open reduction and internal fixation of fractures is pain over prominent metallic implants. Chronic discomfort may necessitate elective removal of the hardware after fracture-healing. This complication of the use of metallic implants has stimulated investigation into the application of bioabsorbable screws for the treatment of such fractures [1]. Bioabsorbable implants are widely used in orthopaedic surgery today. Despite the popularity of these implants, some reports of complications continue to appear in literature. After a FEM (Finite Element Method) study in collaboration with the Department of Mechanical Engineering of the University of Trieste, concerning the mechanical properties of the biodegradable plates and screws, we have started to use bioabsorbable plates and screws for treating ankle fractures.
Objective The purpose of this prospective, randomized study was to test the safety and efficacy of polylactide screws for the fixation of displaced malleolar fractures of the ankle compared also with metallic osteosynthesis.
Material and methods We report our clinical and radiographical experience on two groups of 30 patients with malleolar or bimalleolar close fractures operated from July 2004 to March 2008. The first group was operated with biodegradable plates and screws and the second similar group was treated with metallic hardware. The fracture patterns, as classified by the system of Weber, were similar, and the two groups had similar proportions of medial malleolar, bimalleolar, and trimalleolar fractures. We have used biodegradable screws and plates produced by Inion Company. Ankle Plates were composed by biodegradable polylactic acid/trimethylenecarbonate copolymer. This copolymer biodegrades in vivo by hydrolysis into L-lactic acid, D-lactic acid and TMC. The Inion Ankle System loses most of its strength after 18–36 weeks and bioresorbs thereafter.
Results The results were evaluated at a mean follow-up of 21 months with Ankle Score by Olerud and Molander. 85% of good and excellent results were obtained with both techniques without any tissue reaction in those treated with biodegradable materials. One patient treated by biodegradable plate and screws presented a light soft tissue reaction after 18 months, resolved after scar revision in local anaesthesia.
Conclusions We think that biodegradable ankle plates seem to be a very interesting way to synthesize ankle fractures and that orthopaedic surgeons can safely utilize this technique in patients with good quality bone [2].
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TRAUMATOLOGY 9

Use of gracilis free muscle transfer for the coverage of the distal third leg skin defect

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Objective Frequently high pressure traumas affect the distal third of the leg, involving bone and soft tissue. Skin defects are always a surgical challenge. The presence of an ulcer or the exposition of means of fixation are recurrent complications in lower limb traumas and expose wound to an high infection risk and sometimes prevent, contraindicate or delay orthopaedic treatment.
Material and methods Since January 2007 till December 2009, 10 patient were treated in our Unit for soft tissue defects of the distal third of the lower limb with a free gracilis muscular transfer. In all cases we performed an arteriography of the interested limb to outline the real vascularisation after trauma and focus the receiving vessel. In patient with bone infection the pre-operative and the post-operative evaluations were performed with marked leukocyte scintigraphy.
Results Skin closure took place in 30 days, no major complications were encountered.
Discussion The vascular pattern of this particular district predispose to an easy distress of the skin and soft tissue after traumas or after orthopaedic surgical procedures. Especially for this unstable and unreliable vascular pattern the common technique of skin coverage using local fascio-cutaneous flaps commonly does not provide good results in term of quality and thickness of tissue and especially in term of consistent vascularisation. On the contrary the use of a free microsurgical muscular flap transposes an unlimited extension vascularised tissue. This procedure allows a wide debridement, including bone wiping, reducing infection risk; moreover the transplant of a well vascularised tissue is a good protection for bone infection. Another significant advantage of this technique is the possibility to perform in the same procedure the bony fixation and the skin closure. Our first choice free flap is the gracilis muscular flap; this solution allows a really minimal morbidity at the donor site and offers an exceptional adaptability of the flap at the receiving site, in term of quality of wedge and depth. Moreover the muscular flaps reduce their thickness significantly in 6–8 months, adapting themselves at the shape of skin defect.
Conclusions We consider the free gracilis transfer even associated with bone stabilization the gold standard procedure to treat high energy traumas of the lower limb with soft tissue defects.

Clinical and radiographic outcomes after minimally invasive locking plating of distal tibia fractures

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Objective Assess the bone union rate, deformity, leg-length discrepancy, return to pre-injury daily and sports activities and infection rate in a selected group of 21 patients who underwent minimally invasive osteosynthesis of close distal tibia fractures with Locking plate (LP).
Material and methods We prospectively included patients with closed distal tibia and fibula fractures, without any previous or present ipsilateral leg fracture. There were 9 women and 12 men, ranging in age from 25 to 66 years. Fractures were classified according to AO classification. There were 12 type A, 5 B, and 4 C fractures. Clinical, functional, and radiographic evaluations were scheduled at 6, 12, 24 weeks, 1 year, and then annually. Results were classified in accordance to criteria developed by the Association for the Study and Application of the Method of Ilizarov (ASAMI). The results were divided into bone and functional results. For bone results four criteria were evaluated: union time, infection, deformity ($< 7°$), and leg-length discrepancy (< 2.5 cm) at standard long-leg radiographs. The functional results were based on five criteria: limp, equinus rigidity of the ankle, soft-tissue dystrophy, pain, and inactivity (unemployment because of the leg injury or inability to return to daily activities because of the leg injury).

Results The average follow-up was 2.8 years (range, 2 to 4). Two patients were lost to follow-up. Union was achieved in all but one patient. Four patients had angular deformity <7°. No patient had a leg-length discrepancy >1.1 cm. Five patients had range of motion of ankle <20° compared with the contralateral side. Sixteen patients had not returned to their preinjury sporting or leisure activities. Three patients developed a delayed infection. According to the ASAMI criteria, there were 15 excellent, 3 good and 1 poor bone results and 11 excellent, 3 good and 5 fair functional results.
Conclusions The high percentage of unions and the low rate of complications show that LP is a suitable device for treatment of distal tibia fractures. The level of physical activities appears permanently reduced in most of patients. The cost of the LP, the technically demanding procedure, and the increased exposure to radiation to perform the procedure should be considered when comparing the efficacy of this device to the normal plates. Only future prospective randomized studies may be able to clarify these issues.

Treatment of closed shaft tibial fractures with titanium locked intramedullary nail: clinical results and complications

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Objective Aim of this study is to analyze the clinical and radiographic results in patients with closed shaft tibial fractures treated with the last generation titanium intramedullary nails and their influence on healing time, functional recovery and return to normal activity and complications.
Material and methods The study evaluated 48 patients (49 fractures) treated in our Department between January 2007 and September 2009. According to the AO classification, 28 fractures were type A, 18 type B and 3 type C. We used locked nailing only in 24 fractures. The average follow-up was of 18 months (range, 6 to 38) and we evaluated knee and ankle articularity, muscle trophism, residual pain, healing time and complications comparing the results between locked nailing and not-locked.
Results All fractures healed in an average time of 17 weeks (min.10, max. 46 in a patient with not locking nail). The anterior knee pain was reported in 6 patients with locked nailing and also in 6 patients with not-locked nailing. The ankle pain was prevalent in locked nails. Complications included a less than 10° degrees defect of external rotation in 2 patients with locked nailing, and in 8 patients with not locking nail; there were no defects of internal rotation in locked nailing, while in not-locked nailing there were 3 cases with a more than 10° degrees defect.
Discussion The last generation titanium intramedullary nails allow an anatomical and a stable fixation of the fractures, with early and active mobilization leading to optimal recovery.
Conclusions The locked intramedullary nailing (with secondary dynamization) represents the treatment of choice in closed shaft tibial fractures, because it prevents the onset of angular and rotational severe defects with minimal complications. Moreover the latest generation titanium nails guarantee a high tolerability and technological advantages for the intraoperative management of fractures.

TRAUMATOLOGY 10

Proximal humeral fractures: double minimally invasive surgical approach using Philos locking plate

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Objective We propose a double minimally invasive surgical approach for treatment of proximal humeral fractures, using Philos locking plate.
Material and methods Ten patients, affected by proximal humeral fracture without articular surface involvement, were surgically treated; posterior dislocation of humeral head was also observed in a patient. All the bone fragments were reduced using a 3-cm trans-deltoid approach. Philos locking plate was applied after reduction and distally stabilization through a second surgical approach (1–2 cm) using a cortical screw; plate was stabilized proximally and distally using angular screw fixation eventually.
Results Post-operative radiograms were performed. Quality of reduction was assessed by an independent orthopaedic surgeon. Good or excellent reduction was obtained in all patients.
Discussion and conclusions Deltopectoral approach for the treatment of complex proximal humeral fractures can be difficult because of the fracture morphology. Preliminary results of this study confirm that double minimally invasive trans-deltoid approach for locking plating could offer a better alternative to deltopectoral approach, according to "tissue sparing surgery" principles.

Complex fractures of the proximal humerus treated with last generation angular stability plates

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Objective The aim of our study was to evaluate the clinical and radiological results in patients treated with the last generation angular stability plates for displaced fractures with three or four fragments of proximal humerus.
Material and methods Sixty patients (47 female and 13 male, mean age 62 years) were surgically treated between June 2007 and September 2009. Eighteen patients had a rotator cuff tear and 3 patients had a radius distal fracture. The average follow-up was 15 months (range, 5 to 34). All the patients were assessed with the Constant Score. The radiological evaluation focused on humeral head/shaft angle, humeral head height and lateral offset.
Results The average Constant Score was of 74 (min 40, max 90). The results were negatively influenced by the occurrence of the rotator cuff tear and by the poor participation of the older patients to the rehabilitation. The best results were obtained by the young and working patients. All fractures healed in an average time of 2 months. The deformity of the humeral head in varus did not influenced the functional results. Among the relevant complications there were 3 cephalic necrosis cases, 1 non-union surgical neck case and 1 case of radial nerve paralysis.
Discussion The new generation plates allow a better and safer management of the displaced fractures in the osteoporotic bone avoiding the mobilisation of the screws and preserve the soft tissues.

Conclusions The use of the last generation plates ensures an improvement on keeping the setting, an early mobility of the shoulder and an adequate functional recovery comparing with other systems of stabilization.

Closed displaced mid-shaft clavicle fractures. Non-operative treatment

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Objective Closed displaced mid-shaft clavicle fractures used to be treated non-operatively and many studies in the past reported a high rate of good results. However more recent studies reported poorer results following non-operative treatment, whereas the results of operative treatment improved considerably. We report our experience of closed displaced mid-shaft clavicular fractures non-operatively treated.
Material and methods One hundred Edinburgh type 2B clavicle fractures in 100 patients (78 males and 22 females) aged between 18 and 67 years (mean 32 years) were observed. All patients were treated using a figure-of-eight bandage. Clinical and radiographic assessment was performed at the time of trauma, after 1, 2 and 3 months from trauma and then at an average follow-up of 3 years (range 1–5 years). At last follow-up the outcomes were rated using the DASH score.
Results Ninety-seven out of 100 fractures healed. Three non-unions were observed. Average time of healing was 9 weeks (range 8–12 weeks). Average DASH score was 24 (range 0–78), and based on it 81 patients presented excellent results: 12 good, 5 fair and 2 poor.
Conclusions We believe that non-operative treatment is still appropriate in most cases, allowing to achieve good results without the potential complications of surgery. We recommend surgical treatment only in presence of vascular or neurologic complications in progress, representing a surgical emergency.

Complex carpal traumas sometimes misunderstood: the trans-scapho-lunate dislocations and their treatment

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Carpal perilunate dislocations with associated fracture of the scaphoid are rare but complex lesions. For this reason the diagnosis is often delayed. In perilunar dislocations (about 5% of all carpal injuries) there is loss of contact between the capitate and the lunate. The scaphoid fracture is present from 43% to 65% of cases. Perilunar dislocations affect mostly young male adults (with high-energy trauma) and often remain undetected. In 28% of cases they are associated with a median or ulnar nerve compression. The diagnosis is radiographic, often using associated CT scans. The mechanism of injury is often indirect (hyperextension-ulnar deviation-supination of the wrist). We will describe six cases of transcapholunate fracture-dislocations treated at our Centers between March 2006 and May 2008 [all male, mean age 30.5 years (range 19–43)]. The diagnosis of scaphoid fracture was always made in the Emergency Room while the diagnosis of associated dislocation of the lunate was misunderstood in 2 cases. In two cases there were associated injuries at the ipsilateral limb. Reduction of the fracture-dislocation was always performed. In one case, reduction and intervention were performed 20 days after the trauma. The procedure always consisted in the synthesis of the scaphoid (percutaneous 4, open 2) and evaluation of other associated lesions (2 cases treated). All patients were subjected to a follow-up (average 15.8 months, min. 9–max. 34) according to various criteria (radiographic, Mayo Wrist Score, Dreiser, Jamar). In 5 cases the result was excellent. Radiographic consolidation of the scaphoid fracture was observed within 2 months in all cases except one. All the patients regained sports and job level as previously to trauma. These lesions are rare but feared for their complications: osteonecrosis and scaphoid nonunion, deformity VISI (Volar Intercalated Scapho-Lunate Instability), Reflex Sympathetic Dystrophy Syndrome (RSDS), stiffness and arthritis of the wrist. Correct diagnosis is important (recognize dislocation!) as an early treatment. We always recommend first of all the reduction of dislocation and then the stabilization of the scaphoid fractures and other associated lesions.

BASIC RESEARCH 1

Thermal and mechanical treatments to improve the crystallinity of crosslinked-UHMWPE

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Objective During the production of crosslinked Ultra High Molecular Weight Polyethylene (X-UHMWPE) the thermal treatment (remelting) reduces the formation of free radicals during radiation crosslinking but decreases several mechanical properties. Free radicals are the major responsible for the secondary oxidation. It is therefore of great value to increase the crystallinity of remelted and crosslinked UHMWPE and to preserve mechanical properties, which are mostly important during uniaxial forces loading especially in knee arthroprostheses. We hypothesized that uniaxial compression and thermal treatments could disentangle UHMWPE macromolecules and would increase the crystallinity.
Material and methods Cylinders of GUR 1050 UHMWPE (Ticona, TX) were gamma-irradiated, remelted at 170°C for 4 h, cooled and sectioned into disks (initial height = 26 mm). Using a hydraulic press, the cylinders were heated to 130°C (group A and B) or to 150°C (group C) and compressed to several progressive compression ratios and then water-cooled to room temperature. The samples were sectioned. One section of each samples was analyzed (group A1, B1, C1), the other section was thermally treated for 24 h at 130°C (A2, C2) and 145°C (B2) and then analyzed. To determine the peak temperature and the degree of crystallinity, a Differential Scanning Calorimeter (Perkin Elmer Pyris 6) was used for all the samples.

Results In all samples the crystallinity was within a range of 42%–48%. In the conditions of this experiment a statistically significant increase in crystallinity could not be observed. In fact, the crystallinity slightly decreased with the increasing compression ratio. The applied thermal treatment increased the crystallinity for group C2 and B2 and not for group A2.

Discussion and conclusions The improvement of the mechanical properties of the crosslinked polyethylene is a challenge for all biomaterialists. Thermal and mechanical treatments represent an interesting solution. Nevertheless, at the tested conditions, the post-deformation thermal treatments, whether melting or annealing, did not substantially change the crystallinity. However, several studies showed that uniaxial compression leads to disentanglement, and disentangled chains can easily be incorporated into crystals, leading to increase in crystallinity. Further studies with different heating temperatures and different compression ratios are mandatory to verify the initial hypothesis.

A novel titanium surface treatment for superior orthopaedic implants osseointegration

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The clinical success of uncemented prostheses is due to their optimal primary stability and biological osseointegration of their bone-contacting surfaces. The latter is achieved through metallic porous materials, often coated of deposited plasma-sprayed HA.

Major HA-coating limitations are:

1. Mechanical adhesion may not be sufficient, with debonding risk during prosthesis impaction;
2. Coating resorption occurring with time until disappearing;
3. Plasma-spayed HA deposition is just a "line of sight" process without offering an actual entire 3D porous coating.

It would be instead better aiming at a Ca–P ions-enriched porous surface continuous with the metal substrate stimulating the bone remodelling process like HA does, without time-dependent loss of morphochemical properties.

With this goal, "BioSpark" technology, able to promote and speed up the bone-implant osseointegration processes, was developed in 2002 by Milan Politecnico in cooperation with Brighton University and CNR. BioSpark works throught an electrochemically induced Titanium-Oxide superficial layer modification, bringing to a microporous and nanorough surface morphology, strongly enriched by Ca and P ions, according to the typical HA Ca/P ratio. Resulting from an electrochemical Ti modification rather than being an actual coating, the Ca–P ions-enrichment and the morphological change involve the whole porous material surface. The BioSpark treatment captures the Ca–P ions into the surface oxide, preventing their resorption, keeping at once unchanged their osteoinductive properties across time.

BioSpark-treated Titanium shows a typical nano trabecular morphology, bone-like similarly to HA. In vitro histological studies [1] exhibited selective protein (fibronectin) adsorption, quicker and more intensive osteoblasts adhesion and cells differentiation. In vivo studies on sheep femurs [2] run at Rizzoli Institute showed a significant bone-implant-contact at 8 weeks follow-up on dental implants, application which has seen BioSpark treatment used already since more than 5 years.

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Microstructure and mechanical properties of the high-porous metallic biomaterials to be used in orthopaedic applications: trabecular titanium

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The mechanical properties and porosity dimension of the biomaterials utilized for orthopaedic implants play a crucial role in orthopaedic surgery outcomes. The high-porous biomaterial investigated in this work, commercially called Trabecular Titanium(TM), cannot be obtained by traditional machining, but is produced using Electron Beam Melting (EBM). EBM technology can be used in orthopaedic biomaterials (pure Titanium or Ti6Al4 V alloy) prosthetic components with controlled porosity variation to enhance the biological fixation maintaining the good mechanical properties of an implant.

Tests were performed on two different samples in Trabecular Titanium: with smaller (sample A), and bigger (sample B) singular cell porosity dimension. Relative density was evaluated using different methods, the mean diameter of the open porosities was calculated by Scanning Electron Microscope images; the composition was evaluated using Energy-Dispersive X-Ray Spectroscopy; the microstructure (α-β) was investigated using chemical etching and, the mechanical proprieties were investigated using UMTS. Moreover, static mechanical tests (i.e., adhesion, traction, and compression) are performed. The mean porosity value obtained was comparable with spongy bone (63% for A and 72% for B). According to Literature data, the mean diameter of the single porosity (650 μm for A and 1400 μm for B) may promote osteogenic processes and secondary adhesion of the implants to bone structure. Vickers micro−hardness tests and the metallographic attack showed that the microstructure is fine, uniform and well distributed. Mechanical tests proved that sample (A) was more resistant than sample (B), even if the last one shows an elastic modulus closer to the spongy bone values. All together, these results demonstrate that the Trabecular Titanium can be used in orthopaedic applications and may provide a successful options for arthroplasty procedures. However, clinical experience and research in the coming years will establish its efficacy in this regard.

Histological changes after vertebroplasty with calcium-phosphate cement and PMMA in an experimental animal model

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Background Vertebroplasty with use of polimethylmethacrilate is an effective procedure in the treatment of some specific painful lesions of the spine such as osteoporotic compression fractures [1], spinal

myeloma, haemangioma and metastatic lesions. The purpose of this study is to illustrate the histological and radiographic findings and to determine whether there was a difference between vertebroplasty with PMMA cement and vertebroplasty with calcium phosphate cement in the surrounding tissue of the sheep spine.

Material and methods Between December 2005 and November 2006, 16 sheeps underwent vertebroplasty procedure. The cranial vertebral body was filled with PMMA (Spineplex) and the caudal one was filled with calcium phosphate cement (Callos). Post-operatively all animals underwent plain X-rays. Eight animals were killed after 3 months and the other 8 after 9 months. After sacrifice the vertebral bodies were dissected and standardized.

Results No complications were observed in any of the procedures and during recovery. The estimated amount of cement that was injected into the vertebral body was approximately 0.5 ml. Regarding the inflammatory reaction surrounding the cement, a difference was found between PMMA cement group and calcium phosphate cement group. A mild inflammatory reaction was present in 6 vertebral bodies treated with PMMA cement at 3 months and in 5 after 9 months but was absent in all specimens that received calcium phosphate cement. A thin and complete fibrous layer surrounding the cement indicating incomplete osseointegration was found in almost all vertebral bodies that received PMMA. In 3 vertebral bodies that received calcium phosphate cement an incomplete thin layer of fibrous tissue was found indicating that in the majority of cases the osseointegration was complete. In all specimens calcium phosphate cement was gradually replaced by bone, while maintaining its mechanical integrity in the vertebral body.

Conclusions The PMMA and the calcium phosphate cement both seem to be adequate bone-void fillers in terms of biological behaviour in the vertebral body. In conclusion we can say that calcium phosphate cements might be a better choice than PMMA cement if long-term biocompatibility becomes an issue and for this idea we postulate that calcium phosphate cements may be preferred over PMMA cement particularly when vertebroplasty is to be performed in younger patients.

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Evaluation of coagulation parameters and osteogenic growth factors contained in platelets in patients with osteonecrosis of the femoral epiphysis

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Inherited or acquired thrombophilia and hypofibrinolysis are considered important risk factors for idiophatic osteonecrosis (ON). The first part of this research deals with the study of the association of ON with coagulation abnormalities. Fifteen patients with idiopathic ON and 12 with corticosteroid-associated ON were compared with 42 healthy controls. Plasminogen was higher in idiopathic ON while patients with corticosteroid-associated ON showed a reduction of protein C levels and an increase of D-dimer.

The frequency of genetic mutations that favour thrombophilia in ON patients was not significantly different from controls. Most of the patients with idiopathic or secondary ON were smokers. Smoking is considered a risk factor for thrombophilia, therefore these data suggests that the pathogenesis of idiopathic ON of the femoral head mainly depends by an acquired thrombophilic state, eventually favoured by nicotine.

At present, not much it is known about the concentration of the growth factor (GF) released from the platelets of ON patients, however, platelets gel has been proposed as an adjuvant for ON treatment. For this reason, the second part of this research focused on the release of osteogenic growth factors by platelets derived from patients. TGF-β1 and PDGF-BB were measured on platelet lysate to evaluate the total quantity of GF contained in the platelets and on supernatant of platelets activated by thrombin to evaluate the release reaction. Both the releasates and the lysates deriving from the patients showed higher levels of TGF-β1 and PDGF compared to controls. In conclusion, in ON, the levels of TGF-β1 and PDGF in platelets were increased in comparison to controls. Taking into consideration these new findings, the data outlined in this research give a base for the application of platelet gel in the treatment of ON patients.

Biomechanics of fracture healing stimulation with teriparatide

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Fracture consolidation would be a significant goal to achieve as early as possible, but pharmacological treatment has been neglected until now. Teriparatide (PTH1-34) can play a major role in new bone formation. Poor attention was dedicated to natural callus formation avoiding any surgical intervention.

Our study aims to define teriparatide role in early bone formation, in an original murine model of closed tibial fracture. Mice were treated (daily or every 3rd day) with teriparatide (between 0 and 40 μg/kg) and sacrificed at 28th day to define the best therapeutic scheme, or treated daily with 40 μg/kg and sacrificed between 9 and 28 days to monitor callus with and without treatment. Callus was labeled by tetracycline incorporation and studied with histomorphometrical analysis.

PTH1-34 administration significantly increases the fluorescence/area ratio from 13rd day until 28th day. The highest ratio appears for both groups at day 18th, being the tetracycline incorporation always higher in treated group. No significant differences have been evidenced in callus section area between treated and control groups at any time point, or in the different time points considered within the same group.

Daily administration of 40 μg/kg of teriparatide, after 28 days treatment, induces the biggest callus area (though not significant) and highest fluorescence. 40 μg/kg every 3rd day and 20 μg/kg daily increase section area, but fluorescence intensity is not proportionally augmented in comparison with control animals.

In our model, the consolidation peaks at day 18th, and PTH1-34 administration doesn't modify the natural trend of callus evolution. Nevertheless, PTH1-34 treatment increases callus mineralization, without appreciably influencing callus dimensions. The best results are achieved with daily administration of 40 hμg/kg of PTH1-34.

Microhardness assessment was performed 15 days after fracture. Significant differences in microhardness of callus *vs.* fractured bone

appeared in 3/5 control mice; treatment with PTH1-34 increased callus microhardness while did not change bone microhardness.
Our results suggest the existence of a natural window of treatment efficacy in mouse peaking 18 days after fracture. Healing processes are anticipated and enhanced from early teriparatide administration.

BASIC RESEARCH 2

Co-cultures of juvenile and adult human cartilage fragments: in vitro study for one-stage cartilage repair procedure

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Introduction Autologous cartilage fragments showed good clinical results in one-stage cartilage repair. Juvenile chondrocytes showed superior capabilities of producing extracellular matrix. This in vitro study is a proof of concept of using allogenic juvenile and autologous cartilage fragments for a one-stage cartilage repair procedure. Our starting hypothesis was that adult and juvenile cartilage fragments in co-culture would produce a matrix biochemically and histologically superior to isolated adult cartilage cultures and inferior to juvenile ones.
Material and methods Adult cartilage was harvested from 3 different intraoperative pieces: (a) 62 yo female, with severe knee arthritis that underwent total knee replacement (WE); (b) 69 yo female, with moderate knee arthritis that underwent unicompartmental knee replacement (DD); (c) 18 yo male, affected by hip osteochondral defect that underwent hip arthroscopy (GC). Juvenile cartilage source was ISTO technologies. Cartilage fragments were manually minced (pieces <1 mm). The cartilage of every patient was cultured alone and with juvenile fragments. Juvenile cartilage as well was cultured alone. Each culture was made both with agarose and with a Hyaluronic-Acid Scaffold (Hyaff 11, Fidia, Italy). Two cultures per each type were made (total 28). The cultures underwent biochemical (proteoglycan/DNA ratio) and histological (Safranin O and collagenII immunofluorescence) evaluation at 2 and 6 weeks. Statistics: ANOVA ($p < 0.05$).
Results At 2 weeks chondrocytes migration out of the fragments was detectable, but no statistically significant differences were noted between the groups. At 6 weeks, co-cultures and juvenile cultures showed significantly better biochemical and histological properties (Fig. 1), compared to isolated adult cultures. Co-cultures showed properties superior to isolated juvenile cultures $p > 0.05$. No significant differences were noted between agarose and Hyaff 11.
Discussion The null hypothesis that in the co-cultures (1:1) the value of PG/DNA ratio and Saf-O positive cells would have been comparable to the mean value of isolated adult and juvenile cartilage fragments cultures was refused. In co-cultures the values were significantly higher than expected. This indicates a stimulation of adult cells by juvenile ones.

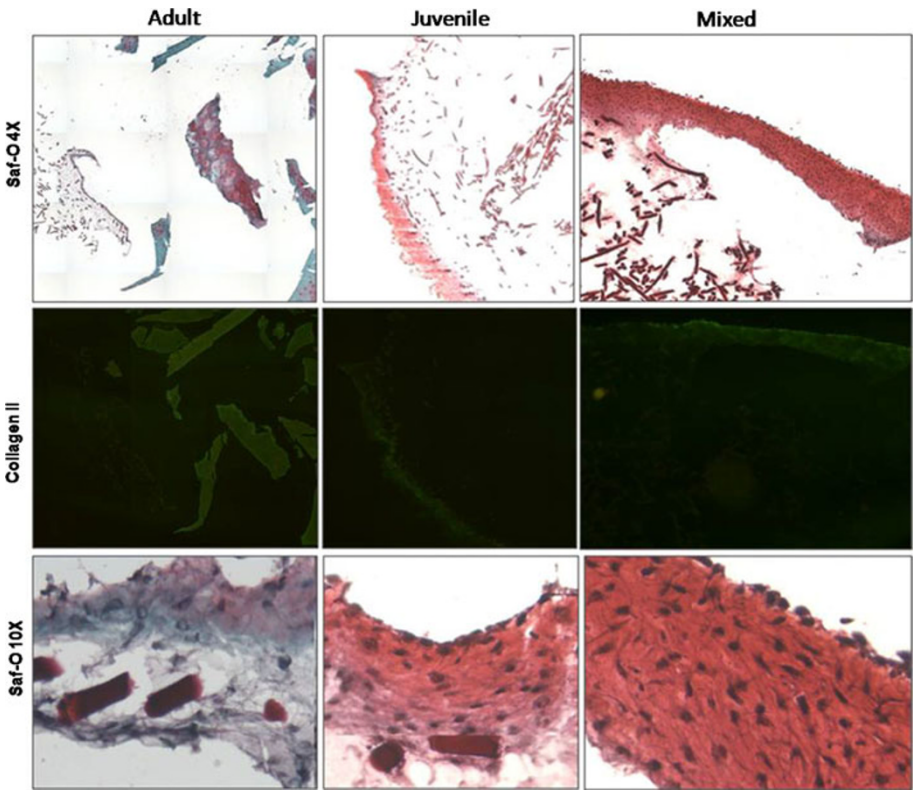

Fig. 1

Synergy of growth factors and mineralizing agents in bone remodelling: assessment on cultured osteoblasts for tissue engineering

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Objective We have investigated and compared the influence of three isoforms of transforming growth factor beta (TGF-ß1, TGF-ß2 and TGF-ß3), three fibroblast growth factors (FGF-2, FGF-4 and FGF-6) and the active metabolite of Vitamin D [1,25-(OH)2D3] on proliferation, alkaline phosphatase activity and mineralization of human primary osteoblasts (hOB).
Material and methods HOB were cultured for a period of 24 days and divided into the following groups relating to the GF and/or mineralizing agents added: untreated cells (negative control), FGF-2, 4 and 6 respectively, TGF ß1, ß2 and ß3 respectively, Vitamin D. Proliferation was assessed via ATP + Luciferin + O2 α Oxyluciferin + AMP + PPi + CO2 + light, differentiation via P-nitrophenilphosphate + dietanolamine α P-nitrophenol, mineralization via Calceine staining and densitometric quantification.
Results TGF-ß isoforms and three FGFs examined have been proved to be inducers of osteoblasts proliferation (higher extent for TGF-ß and FGF-2) and inhibitors of alkaline phosphatase activity and osteoblasts mineralization. Combination of these growth factors with the active form of Vitamin D induced osteodifferentiation. In fact Vitamin D showed an additive effect on alkaline phosphatase activity and calcium content, induced by FGF-2 and TGF-ß in human osteoblast.
Conclusions These results highlight the potential of proliferating cytokines combination with mineralizing agents for in vitro bone growth induction in bone tissue engineering.

NGF and TrkA receptor expression in chronic tendon ruptures: potential role in the pathogenesis of degenerative tendon lesions

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Aim of our study was to investigate the expression of nerve growth factor (NGF) and its tyrosine kinase receptor (TrkA) on tendinosic tissue harvested from Achilles and rotator cuff tendons. The presence of NGF and TrkA receptor was proven through immunofluorescence. We randomly recruited 6 patients that underwent rotator cuff arthroscopic repair and 10 patients that were treated for an acute Achilles tendon lesion. During surgery we harvested samples of the rotator cuff and of Achilles tendon. Furthermore we took a sample of macroscopically healthy tissue from each Achilles tendon.
From each specimen 4 slides were obtained. Two slides were employed for the search of NGF, one was treated with specific antibodies and marked with FITC (Fluorescein Isothiocyanate Conjugated), the second slide was for control purposes and was exposed to FITC, but without prior exposition to the specific antibody. The same procedure was repeated to obtain on two more slides in order to repeat the search for Trka, with specific antibodies. All the slides were studied on a fluoromicroscope.
The analysis of these specimens revealed the presence of the NGF and of the TrkA in all the rotator cuff specimens: the immunoistochemical reaction between the specimens and the specific antibodies marked with FITC was seen under fluoromicroscopy, but in none of the control cases treated with only FITC.
The samples of Achilles tendon revealed the presence of NGF in 9 of 10 cases. In one case the sample was negative for NGF and TrkA receptor and no inflammatory reaction was spotted.
The specimens harvested from the macroscopically healthy Achilles tendon revealed no inflammatory reaction and immunofluorescence revealed no NGF or TrkA receptor expression.
There is considerable evidence that shows that the system constituted by the NGF and his high-affinity receptor TrkA plays a fundamental role in the molecular processes underlying the main forms of persistent pain.This indicates a possible therapeutic area for the antibodies that could block the NGF/TrkA system, in order to modulate the frequency and the duration of the action potential of nociceptive neurons during chronic inflammation.
NGF and TrkA were absent on normal tissue and increased on degenerative tendon specimens. These findings could suggest a role of NGF in the pathophysiology of degenerative tendon rupture.

Bioactive micro-structured scaffold for annulus fibrosus repair and regeneration

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Objective Annulus fibrosus (AF) tissue engineering is reaching increasing interest [1] in developing strategies to both reduce recurrent disc herniation (DH) rate and increase effectiveness of intervertebral disc regeneration techniques. This study evaluate the use of a bioactive microfiber scaffold in Poly-L-Lactic Acid (PLLA) releasing the growth factor TGF-β1 and investigate both cell toxicity and the extracellular matrix produced by bovine AF cells (bAFCs) and human mesenchymal stem cells (hMSCs) cultured on these scaffolds in vitro.
Material and methods Scaffolds were fabricated by electrospinning a PLLA solutions loaded with TGF-β1 and characterized in terms of morphology and release rate of TGF-β1. Bare PLLA scaffolds were use as control. bAFCs and hMSCs were cultured on the scaffolds and cell toxicity was evaluated at 4, 6 and 24 h. bAFCs were seeded at the density of 5×105 cell/cm^2 on the scaffold and cultured for 3 weeks. bAFCs were tested to quantitatively assess glycosaminoglycans (DMMB assay) and total collagen production (Sirus Red Assay). Histology was performed and the neo-ECM thickness measured.
Results PLLA and PLLA/TGF-β1 membranes were composed by fibers with diameter of 1.5 ± 0.9 μm and 0.6 ± 0.2 μm respectively. The scaffolds were not toxic for both hMSCs and bAFCs at all time points. PLLA/TGF-β1 released TGF-β1. bAFCs cultured on PLLA/

TGF-β1 deposited a significant greater amount of glycosaminoglycan and total collagen than the control with higher neo-ECM thickness.
Discussion and conclusions PLLA/TGF-β1 scaffold releasing TGF-β1 induces an anabolic stimulus on bAFCs mimicking the ECM three-dimensional environment of AF tissue. This bioactive scaffold shows encouraging results which could allow to find an application to repair the AF after discectomy and prevent recurrent DH. The scaffold could be associated with hMSCs for tissue engineering strategy in the treatment of intervertebral disc degeneration.
Reference
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BASIC RESEARCH 3

Role of autologous adipose-derived stem cells in the early phases of the repairing process of critical bone defects: a study in a rabbit model

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Bone defect can be provoked by several pathological conditions, like bone tumors, infections, major trauma with bone stock loss. Surgical techniques currently used for treating bone defects may count on different alternatives, each one of them characterized by both specific complications and drawbacks. Nowadays, an ideal alternative is the use of osteoconductive synthetic bone substitutes either alone or in combination with autologous cells able to enhance the regeneration process and thus to provide better results. Adipose-derived stem cells (ASCs), with their great availability and osteogenic potential may represent, in association with specific scaffolds, a novel and efficient approach for bone regeneration.
In this study, autologous rabbit ASCs were expanded in culture and inserted in full-thickness bone defects in the proximal epiphysis of tibia of twelve New Zealand rabbits. Defects were implanted with graft material as follows: untreated (control), hydroxyapatite (HA) disk, ASCs alone and hydroxyapatite ASCs seeded-disk Each rabbit ASCs population was tested in vitro: they all showed a high proliferation rate and a marked clonogenic ability and osteogenic differentiation potential. Eight weeks after implantation, macroscopic analyses of all the samples showed satisfactory filling of the lesions without any significant differences in term of stiffness between groups treated with or without cells ($p > 0.05$). In both the scaffold-treated groups, a good osteointegration was radiographically observed. Even if HA was not completely reabsorbed, ASCs-loaded HA displayed a more efficient scaffold resorption than the unloaded ones. Histological analyses showed that the osteogenic abilities of the scaffold-treated defects were greater than those of scaffold–free samples, and in particular new formed bone was more mature and more similar to native bone in presence of ASCs. These results indicate that autologous ASCs-hydroxyapatite construct is a potential treatment for the regeneration of bone defects

In vitro testing of biomaterials osteo-inductive properties by human adipose-derived stem cells

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The clinical success of the implants is related to their early osteointegration which depends primarily on the properties of the surface. It is known that an increased implant-surface roughness significantly influences the osteoblastic response, improving their adhesion and proliferation; same results have been described with bone marrow mesenchymal stem cells. Meanwhile, new techniques of surface treatment and coating deposition have been developed to prevent corrosion and debris formation which may cause tissue inflammation, osteolysis and finally the loosening of the implant.
In this study hydroxyapatite (HA), different kind of chemically modified titanium (TIT, TAA) and silicon carbide obtained by plasma enhanced chemical vapour deposition (SiC-PECVD), a novel and promising biocompatible material for the covering of orthopaedic devices, were analyzed for their properties in supporting cell adhesion, proliferation and osteo-differentiation. Human adipose-derived stem cells (hASCs) were used for all these analyses since they possess a multi-differentiative potential and a reduced immunogenicity,features that make these cells useful and suitable model for these tests. We assessed the ability of the tested biomaterials to support hASCs growth, both in non inductive and in osteo-inductive conditions, in comparison with the one of the plastic for traditional monolayer cell culture (PA). Both undifferentiated and osteo-differentiated hASCs well colonized the tested biomaterials without showing any cytotoxic effect. HA, TIT, TAA and SiC-PECVD clearly possessed osteoinductive properties: indeed hASCs cultured on these biomaterials showed a significant increase of osteogenic markers such as alkaline phosphatase activity and calcified matrix deposition in comparison to cells cultured on plastic.
This study suggest the use of hASC cells to test and to predict in vitro the compatibility and the osteo-inductive properties of biomaterials involved in orthopaedic application.

Sheep embryonic stem-like cells allow hyaline cartilage regeneration in sheep full-thickness femoral condyle defects: experimental study

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Surgical techniques used to repair articular surfaces do not give satisfactory and durable results because of the regeneration of fibrocartilage.
To evaluate if sheep Embryonic Stem-like (ES-like) cells engrafted in experimental cartilage defects are able to regenerate hyaline cartilage, the repairing process of articular cartilage in sheep after engraftment

of ES-like cells in full-thickness cartilage defects was examined at 24 and 36 months from surgery. Male ES-like colonies, raised from the inner cell masses (ICMs) derived from in vitro produced (IVP) vitrified embryos, positive for stage specific embryonic antigens (SSEAs), alkaline phosphatase (AP) and Oct4, were transplanted into osteochondral defects of sheep medial femoral condyles. Regenerated tissue was examined by biomechanical, macroscopic, histological and immunohistochemical assays. Moreover, to detect male ES-like cells in regenerated tissue, the Y gene sequence was used as a marker in "in situ hybridization" (ISH) tests.

ES-like grafts at 24 months tended towards a better healing process in both controls (G and ED), confirmed by constant good histological scores, which were close to significant statistical difference, while both controls showed a wide variability. ES-like grafts completely filled the defects, showing more regular surfaces and complete continuity between adult cartilage and regenerated tissue, when compared to the controls. Moreover, 2 ES-like samples, from the youngest animals, showed the presence of mature hyaline cartilage, with collagen type II positivity and proteoglycans in the matrix and chondrocytes distribution in the 3 typical zones of the adult cartilage (deep, middle and superficial zone). However, the superficial layer still displayed the presence of cellular clones, evidencing that the regenerating process was probably still on going. The small number of cells applied might have negatively affected the results, not allowing stem cells to carry out their beneficial stimulation on the regenerative process. No teratoma or inflammatory signs referable to rejection occurred in any of the ES-like samples, probably due to the "immune-privileged" and chondrogenic site of the implant. ISH showed positive intranuclear signals in ES-like derived cells in the new formed tissue, while controls resulted constantly negative. The 36 months results are still on trial, although from very early examination they appear encouraging.

In conclusion, sheep ES-like cells are able to regenerate articular hyaline cartilage when engrafted into sheep femoral condyle full-thickness defects.

Interaction of human mesenchymal cells with a new resorbable phosphate-based glass-ceramic for bone engineering

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Several materials with controlled degradation have been recently developed as scaffolds for tissue regeneration and bone formation. Resorbable ceramics and glasses, such as calcium phosphate or phosphate-based glasses, are highly promising due to their bone-like composition and to the release of ions participating to bone deposition.

In this study 3D resorbable highly porous scaffolds have been prepared via sponge-replication method, using a porous polyurethane foam and a phosphate-based glass belonging to the P_2O_5-SiO_2-CaO-MgO-Na_2O-K_2O group.

Following polyurethane removal and sintering treatment, the 3D S-GC-ICEL scaffold has been characterized using X-ray diffraction, SEM, image analysis, compression test and solubility in simulated body fluid (SBF) and Tris–HCl.

Human bone marrow has been collected from femur of patients undergoing total hip replacement surgery, and stromal cells (MSC), isolated by plastic adhesion, have been expanded in a-MEM with 10% foetal calf serum, ascorbate and dexamethasone. After seeding of MSC on S-GC-ICEL scaffolds, cell viability, DNA content, alkaline phosphatase (ALP) and type I collagen have been assayed, and MSC observed by SEM, at 1, 7, 14 and 21 days.

S-GC-ICEL scaffolds showed a trabecular architecture similar to spongy bone with 80% porosity. After soaking in SBF, an apatite-like layer was found on the surface, due to the bioactivity of the substrate. At 3 weeks from seeding of MSC, about 25% by weight of the scaffold has been lost. MSC adhered to the scaffold with a metabolic activity increasing with time, as well as ALP and type I collagen. Based on these results, the S-GC-ICEL glass–ceramic stimulates the osteogenic differentiation better than proliferation of adult MSC, while being progressively resorbed. This suggests a potential use of S-GC-ICEL as osteoconductive scaffold for bone defects.

Pure chitosan electrospun fibrous scaffolds for orthopaedic tissue engineering

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Objective Chitosan is a natural polymer well characterized for tissue engineering applications. Electrospinning, a technique that allows to obtain micro-nanofibers by the migration of a polymeric solution in an electric field, is frequently used to obtain fibrous scaffolds for applications in regenerative medicine. Electrospinning of pure chitosan is not easy to perform and is usually associated to the obtaining of non-homogeneous fibres and to the formation of beads. Aim of the current work is the fabrication of a defect free pure chitosan electrospun scaffold for applications, to perform its structural characterization and biocompatibility on human mesenchymal stem cells (hMSCs).

Material and methods Chitosan scaffolds were prepared by electrospinnnig, starting from a solution of pure chitosan dissolved in concentrated TFA and DCM. The obtained membranes were cross-linked with glutaraldehyde vapours. The morphology of fibers was observed by Field Emission Scanning Electron Microscopy (FE-SEM). The chemical characterization by Attenuated Total Reflectance Fourier Transform Infra-Red spectroscopy (ATR/FTIR). Membranes were assessed for cytotoxicity (Vybrant Citotoxicity Assay Kit) and cell proliferation (MTT assay) using human mesenchymal stem cells (hMSCs).

Results Electrospun chitosan membranes had continuous, randomly oriented and beads-free fibres, with average fibre diameter of 450 ± 110 nm (range 260 to 640 nm). FTIR analysis confirmed absence of toxic co-solvents in the membrane. Cell viability demonstrated 90% cell viability. Cell proliferation demonstrated a significant increase in of number of cells..

Discussion and conclusions In the current paper, a standardized and easy way to fabricate a cross-linked pure chitosan electrospun membrane without the use of co-solvents was reported. The membrane was characterized in terms of morphology and chemical structure; biocompatibility assay was performed with hMSCs showing biocompatibility and cell proliferation. These results confirm that these electrospun membranes are good candidate as scaffolds for hMSCs application in regenerative medicine. Studies on cell seeding and differentiation of hMSCs on the membrane are currently ongoing to outline the potential role in orthopedic tissue engineering protocols of this biomaterial.