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Amniotic ovine stem – like cells for treatment of spontaneous tendinopathies in the horse

Michele Abate[1], Aurelio Muttini[2]
[1]Università G. D'Annunzio, Chieti, Pescara
[2]Department of Veterinary Clinical Sciences, University of Teramo, Teramo, Italy

In the last decade, the use of multipotential progenitor cells has received a great deal of attention to promote tendon healing. It has become technically feasible to harvest tissue cells, to expand cell population in culture, and therefore to inject them into injured tendon (1). Stem cells (SCs), under the influence of endogenous and exogenous factors, can subsequently differentiate into tissue – specific cells, favouring tendon repair.
Bone marrow – derived SCs have been used in several studies, but also other mesenchymal tissues, such adipose tissue and dermis, have been considered (2).
Recently, Amniotic Epithelial Cells (AECs) have been extensively studied as another interesting source of SCs, for the high proliferative potential in culture, multipotent differentiation ability and easy availability (3). A low immunogenicity have been also suggested by their survival, in some allograft and xenograft studies (4-6). However, the survival has never been studied in tendons xenograft.
Aim of this report is twofold: first, to investigate whether ovine AECs (oAECs) have low immunogenicity, when implanted into spontaneous tendinopathy of the superficial digital flexor tendon (SDFT) in the horse; second, to evaluate whether these cells can enhance the functional recovery following a rehabilitation program. Two racehorses, suffering from monolateral SDFT tendinopathy of the thoracic limb (clinical and ultrasound diagnosis), were studied. Cells were obtained from the epithelial layer of the amniotic membrane of sheep (4) and, before injection, were stained with a vital membrane fluorescent probe to identify the transferred cells into the host tissue. A real time ultrasound (US) guided injection of the affected area inside the tendon was performed, and a total of 7×10^6 oAECs was grafted into the lesion.
After implantation, horses were rested in box for 7 days before starting a rehabilitation program (walking in hand on hard surface, for 15 min, twice a day, until day 40). US controls were performed after 15, 30 and 40 days.
At 40 days, a real – time US guided biopsy of treated area was performed, and the specimens obtained were analyzed for: 1) hematoxylin – eosin (HE) and Herovici histological stainings; 2) nuclear contrast with fluorescent DAPI staining; 3) immunoreactions (IHC) with a cellular proliferation marker Ki67. Histological analyses demonstrated, inside the treated lesion, the presence of cells with the vital probe on their membrane, and newly ovine deposited collagen! fibres (HE staining). No evidence of mononuclear cells population was observed. At US control, after 15 and 30 days, the affected region appeared widened and the hypoechoic areas were still present; at 40 days, in both cases, US imaging demonstrated a more homogeneous pattern of the treated areas, which were reduced in extent and less hypoechoic. Clinical conditions of both horses improved, but they were withdrawn from racing.
This study suggests that transplanted oAECs survive inside tendinopathic areas. Indeed, marked cells are still detectable 40 days after transplantation. Their very low immunogenetic potential could be probably related to the expression of HLA – G, which displays inhibitory functions relevant to immune responses (7, 8).
In addition, on the basis of US and histological results, it can be hypothesized that implanted cells may transdifferentiate into mesenchymal cells and have an healing potential. Indeed, newly ovine formed collagen fibers are seen near the cells, while tendon echotexture acquires a more normal appearance. These results can be also related to the beneficial effects of the rehabilitation program. The mechanical loading, together with the stretching of the tendon, promotes the synthesis of collagen and improves reorganization.

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From muscle research to clinical applications: Do glutamate antagonists aid muscle recovery?

Maria Albani
Laboratory of Physiology, Department of Physiology and Pharmacology, Medical School, Aristotle University of Thessaloniki, Greece

The present review summarizes results of this intriguing field of research which shows that glutamate receptor blockers may represent a promising therapeutic approach to retain nerve and muscle function during neurodegenerative. Ionotropic receptors of glutamate, a major CNS neurotransmitter, such as NMDA and AMPA/kainate have been identified throughout the brain and spinal cord and their activation leads to Ca2+ influx into the cell and subsequent activation of a cell death cascade. As it has been shown, motoneurons are particularly vulnerable to excitotoxic cell death only during the first five days of postnatal life. Glutamate excitotoxicity plays a significant role in this time-dependent process. Blocking of NMDA receptors by various substances rescues motoneurons and increases the number of motor units surviving into adulthood. Various categories of Glutamate blockers (MK801, Mg, PNQX, DAP-5) have various actions on the glu receptors. Besides, the different response between mature and immature motoneurons following injury is attributed to the quantity of glutamate receptors on the cell membrane. The effect of these substances on the recovery of fast and slow muscles after sciatic nerve crush, at critical developmental stages, shows a variable but impressive reverse of the devastating effects on rat muscle properties, which is different between fast and slow muscles.

Autologous platelet rich plasma: a revolution in soft tissue sport injury management?

Isabel Andia[1], Mikel Sánchez[2]
[1]Research Department, Osakidetza Basque Health Service, Zamudio, Spain
[2]Unidad de Cirugía Artroscópica, Clínica USP-La Esperanza, Vitoria-Gasteiz, Spain

The therapeutic use of Platelet Rich Plasma (PRP) is an autologous biotechnology that relies on the local delivery of a wide range of growth factors and cytokines with the aim of enhancing tissue healing. In clinical management of tendon and muscle injuries, the current hypothesis is that local injections of PRPs deliver supraphysiological concentrations of growth factors and cytokines at the injured site, influencing inflammation, angiogenesis, cell migration, proliferation and/or differentiation and ultimately enhancing tissue regeneration (1).
Given the biocompatibility of using the patient's own proteins, safety is guaranteed, simplifying translation from the laboratory to the patient. However the rapidity of translation has sparked debate regarding the level of evidence of clinical benefit needed to introduce PRP technologies in the sports medicine setting (2). PRP therapies have many formulations - mainly pure-PRP and leukocyte-PRP - and procedures for application, but they all try and maximise the cell signals that may enhance tissue healing. Differences in PRP formulation can influence clinical outcome differently, however there is no compelling evidence for preferential use of either pure-PRP or leukocyte-PRP. Fundamental differences between PRP technologies should be identified with good experimental data and extensive clinical details in hand. Understanding both tendon and muscle healing and PRP therapies is an area of research that is critically important in developing optimal formulations and protocols to achieve the intended therapeutic effects. Tissue repair occurs through the dynamic and collaborative interactions of various cell phenotypes involved in angiogenesis, inflammation, and tissue remodelling. In this context inter- and intra-cellular signalling is organized through intricate networks infinitely complex to elucidate. Establishing the cascade of events and the molecular and cellular hierarchy underlying the therapeutic effects of PRPs is a major challenge that may identify windows of opportunities for PRP therapies (3).

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Mechanical stimulation of tendon healing: dose-response and gene expression in rats.

Per Aspenberg
Orthopaedics Division, Department of Clinical and Experimental Medicine, Faculty of Medicine, Linköping University, Linköping, Sweden

Mechanical loading stimulates healing of tendons and ligaments, but how? And how much loading is needed? Achilles tendons were transected in rats. During healing, the rats were tail-suspended but let down for treatmill running during short daily time periods. Results were evaluated mechanically and via gene expression of the whole genome. Results: 15 minutes of daily treadmill running doubled the strength of the healing tendon without causing any increase in its length. Prolonging or repeating the training periods had minimal effects. The improvements in strength were seen also if training was applied only during days 2-5 (the inflammatory phase). The gene expression response after a single loading episode day 5 was dramatic at 3 hours and had vanished after 24 hours, suggesting a need for daily training for an optimal effect. Many regulated genes were involved in inflammation: this included up-regulation of iNOS, PGE synthase, Il-1b and other genes related to these.
There is a connection between inflammation and mechanical stimulation. Contrary to common belief, it seems that mechanical loading can be beneficial also during the early, inflammatory phase of healing. By measuring gene responses as early as possible after loading, it might be possible to identify the initial events, thus approaching the mechanisms underlying the beneficial effects of loading on tissue repair.

Genes and sport

Donatella Barisani
Department of Experimental Medicine, Faculty of Medicine, University of Milano Bicocca

The study of genetic variations, i.e. polymorphisms, in sport medicine has been employed in the attempt to identify predisposing factors to tendon and/ligament lesions.
Tendons and ligaments, such as the Achilles tendon or anterior cruciate ligament are common sites for injuries during sport activities, whereas chronic tendinopathy can affect athlets as well as sedentary subjects. However, similar levels of physical activity do not correspond to similar lesions, thus suggesting that there could be an interaction between external components and the genetic asset of a single subject. The presence of a predisposing genetic background has been supported by the observation of an increase prevalence of the same type of lesion in subjects belonging to the same family (1,2), finding that further suggests that these conditions should be regarded as multifactorial diseases.
The presence of possible differences in allelic or genotype polymorphisms frequencies has been investigated for candidate genes such as collagen 1A1, collagen 5A1, tenascin and MMP3.
Collagen type I is the major component of tendons and ligaments, and it is a heterodimer of two different polypeptides, collagen I□1 and I□2, codified by COL1A1 and COL1A2 genes. COL1A1, on chromosome 17, harbors a G/T polymorphism that alters a Sp1 (transcription factor) binding site, thus causing variation in its transcription (3). The presence of T nucleotide increases Sp1 binding, the transcription of the gene and the production of collagen I□1 (3). The presence of a T/T genotype has been identified as “protective” against anterior cruciate ligament rupture and shoulder dislocation in a Swedish population (4), results subsequently confirmed in a South African cohort (5). On the contrary, no association was detected between COL1A1 polymorphism and Achille tendon injuries (6), although a subsequent analysis pooling data from the different studies reported the T/T genotype as protective against soft tissue ruptures (7).
COL5A1, localized on 9q34, encodes for the □1 chain of type V collagen, which intercalates with type I collagen in tendons and possibly regulates fibrillogenesis (8). Polymorphisms in the 3’ untranslated region of COL5A1 mRNA have

been evaluated using the RFLP technique with specific restriction enzymes, namely DpnII and BstUI in patients with Achilles tendon pathology (9). In particular, the presence of the A2 allele (BstUI RFLP) was significantly higher in controls as compared to chronic tendinopathy, thus suggesting a protective role for this allele (9). The association between BstUI RFLP and Achilles tendonopathy has been further confirmed by analysis of two other cohorts (10), and similar results have been obtained when anterior cruciate ligant rupture were considered, although in this case the difference was observed only in female subjects (11).

The investigation of polymorphisms in other two collagen genes, COL12A1 and COL14A1, did not show any significant correlation between alleles or genotype frequency and Achille tendonopathy (12).

TNC gene, localized on 9q33.1, encodes for tenascin C, an extracellular matrix glycoprotein which could regulate cell-matrix interaction but has also recently been involved in maintaining inflammation (13). Even in the case of TCN polymorphisms, a significantly higher prevalence of specific alleles was observed in patients with Achilles tendon injuries (14).

A significant association was also detected between MMP3 polymorphisms and Achilles tendonopathy, and the additional presence of COL5A1 polymorphism seemed to further increase the risk (15).

Although these data are encouraging, the identification of the genes playing a role in the pathogenesis of these lesions remains complex, due to the fact that many genes could be involved, each one accounting for only a small percentage of the risk. Moreover it must be remembered that the polymorphisms identified so far could be just genetic markers and not correspond to specific variants of the genes directly involved in the pathogenesis of tendon and ligament lesions. Large genome wide association studies are necessary to identify the loci involved, followed by functional studies to assess the role of the identified variants.

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Biochemical markers of muscular damage

Paola Brancaccio
Servizio di Medicina dello Sport, Seconda Università di Napoli, Napoli, Italy

Muscle tissue may be damaged following intense prolonged training as a consequence of both metabolic and mechanical factors. Serum levels of skeletal muscle enzymes or proteins are a marker of the functional status of muscle tissue, and vary widely in both pathological and physiological conditions. Creatine Kinase (CK), Lactate dehydrogenase (LDH), aldolase, myoglobin, troponin, aspartate aminotransferase (AST), Carbonic Anhydrase CAIII (CAIII) are the most useful serum marker of muscle injury, but apoptosis in muscle tissues consequent to strenuous exercise may be also triggered by increased oxidative stress. Therefore, the total antioxidant status can be used to evaluate the level of stress in muscle by other markers such as thiobarbituric acid-reactive substances (TBARS), malondialdehyde (MDA), sulfhydril groups (-SH), reduced glutathione (GSH), oxidized glutathione (GSSG), superoxide dismutase (SOD), catalase (CAT) and others. As the various markers provide a composite picture of muscular status, we recommend to use more than one to provide a better estimation of muscle stress. Therefore, blood analysis and urinanalysis provide a composite picture of muscular status and particularly monitoring of serum enzymes in athletes is a simple and non invasive method which trainers and physicians could improve to know the training status of athletes. In athletes, the study of CK at rest and after exercise could be an important tool for coaches and clinicians (1). Athletes have higher resting CK compared with untrained subjects (2), probably because of the greater muscle mass and the daily training performed. However, after exercise CK serum activity depends on the level of training: although athletes experience greater muscle soreness compared with untrained subjects, their peak serum activity are lower (3). Also, the most marked increase of CK occurs in the less trained subjects (4). Other authors attribute this behaviour to training adaptation, and identified a relationship between peak power and release of CK, with the athletes achieving the lowest peak power showing the greatest increase in CK (5). Noakes, in 1987, hypothesised that subjects with abnormally large increase in serum CK activity after exercise may have unrecognised subclinical myopathy (6). Often, the high serum levels of CK are considered normal in asymptomatic athletes because clinicians know that they are influenced by training, while they can be a sign of silent disease. Indeed, CK serum levels are almost always elvated even in the preclinical stages of frank myopathy (7).

We compared the effects of exercise on serum levels of creatin kinase (CK) in athletes with persistently high CK levels at rest and in healthy athletes.

Eighteen athletes with high serum CK levels at rest (CK > 80 U/L; CK Group) and 25 athletes with normal serum CK levels at rest (CK < 80 U/L; Control Group) were evaluated. Blood samples were collected before, and after a cycloergometer test to exhaustion. The levels of serum CK and its isoenzymes were measured.

In control group, serum CK values at rest were normal; after exercise, they increased slightly, decreasing to the rest level after 48 hours. The CK group had serum CK levels at rest higher than normal (116.56 ± 33.30 U/L). They were still outwith the normal range after 72 hours (116.55 ± 24.84 U/L). Athletes with high serum CK levels at rest had a different kinetics after exercise when compared with healthy athletes, thus they were assessed by a Clinical Genetics consultant, who formulated diagnoses of Myopathy.

Monitoring of serum enzymes in athletes is a simple and non invasive method which trainers and physicians could improve to know the training status of athletes and evaluation of serum CK levels at rest, and the study of its kinetics after exercise, help to identify myopathies often going undiagnosed in athletes.

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Synthetic ligaments: a justified revival?

Giuliano Cerulli
Department of Orthopedics and Traumatology University of Perugia, Perugia; Nicola's Foundation ONLUS, Arezzo

In the second half of the '90's artificial ligaments were once again being considered for anterior cruciate ligament reconstruction. The new artificial ligament was looked upon with skepticism by most orthopedic surgeons due to the bad experience in the '80's. In the years to follow, better knowledge of the causes of failure and an analysis of the literature lead us and other orthopedic surgeons to reconsider the possibility of using synthetic tissue as a graft. We started using the new generation synthetic ligament in ACL reconstruction in 2001 in well selected cases: subjects over 40 yrs old, symptomatic, motivated, needing fast recovery and with little time to spend on rehabilitation. In a second phase and in special cases, such as the chance of a lifetime or for personal motives, we reconstructed the ACL with the synthetic graft in patients under 40 yrs old. From March 2001 to date over 600 ACL reconstructions have been performed by our group. We have evaluated the results of anterior cruciate ligament reconstruction with artificial ligaments at a five-year follow-up.
25 patients have undergone anterior cruciate ligament reconstruction using synthetic tissue and the all-inside surgical technique. The operation was proposed to symptomatic, motivated subjects who needed quick recovery to return to sport or working activities.
For the individual clinical evaluation the VAS, KOOS and IKDC forms were used. An expert neutral "observer examiner" performed the objective clinical evaluation. The subject also had a biomechanical functional assessment: arthrometry, isokinetics and stabilometry.
The subjective clinical evaluation, resulting from the assessment forms used, shows positive results in over 90% of the cases. Similar results were observed following the objective clinical evaluation. The biomechanical evaluation showed excellent or good recovery in the majority of cases. The authors conclude that artificial ligaments are, in selected cases, a valid alternative to the autografts and allografts. In conclusion, based on our experience if the technique is well performed and the patient selection is accurately done we can assure the patients' outcome, which have to date shown to be positive in 95% of the cases. The artificial graft is fully biocompatible and in the near future it will be bioactive.

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Diagnosis and treatment of overload enthesopathies

Maria Conforti
Direzione Generale INAIL Milano

Often, young rheumatic patients, practicing sports, challenge the sport physician for persistent pain. When the pain in an athlete is not caused by trauma or overload, it need exclude rheumatic deseases. In rheumatic patients, the pain can be articular, periarticular, extra-articular, inflammatory and mechanical. The pain can be due to bursitis, tendonitis, enthesopathy and fibromyalgia (3). Inflammatory pain occurs during the night and causes morning stiffness what relief after moderate physical activity. The periarticular tissues may be affected by signs of inflammation such as joint swelling, increased skin temperature, redness of the affected articulation. The mechanical pain occurs during the day getting worse with the load. The rigidity is low and patient have the presence of analgesic muscle contracture, low (or absence) are signs of inflammation. Enthesitis refers to the inflammatory pathology in the tendons and ligaments insertional area (1). The most common sites of inflammation are the Achilles tendon enthesis, the plantar fascia enthesis of the radial wrist extensor or adductor muscles enthesis, gave rise the so-called “groin pain “ The enthesopathy can be diagnosed, at an early stage, with power Doppler ultrasound examination or with baseline MRI sequences with high contrast resolution (2). With the ultrasound B mode it will highlight the enthesis changes as thickening or calcification is that periosteal tendon, while with Power it will highlight increased vascularity, acute inflammation index.

In the presence of inflammatory enthesopathy in a athlete, especially in Achilles tendon and plantar fascia it must be always excluded the presence of rheumatic diseases like ankylosing spondylitis, psoriatic arthritis and Reiter’s syndrome. Italian Sport Medicine can claim 35 years of experience, due to the requirement of the capability medical exam, and therefore can today express an authoritative opinion on how to grant suitableness in relation to Ankylosing Spondylitis. It is anyway very difficult for a sport physician to technically know every sport discipline, every pathology, and it is impossible to guarantee suitability for a sport for one whole year. Therefore the position of the sport physician has to be taken with consciousness and extreme care, using the experience of Rheumatologists colleagues. The aim is to frame pathological affections which, due to physical practice, can cause risks for the athlete and others (4). There are no scientific works on the suitability evaluation related to rheumatic illnesses. There are only indications related to permanent or temporary orthopedic pathologies. In the latter case suitability is suspended for 6 months waiting for the spontaneous or surgical resolution, followed by a new evaluation. Rheumatic patients should find a well balance between rest and activity (5). A symptom of many rheumatic illnesses is fatigue, but with no action be the patient it can develop in to muscular atrophy and secondary rigidity. Physical exercise, even if fatiguing and painful at first, can reduce pain and increase flexibility, muscular strength and resistance. Exercise can also lead to weight loss, which on the other side reduces stress on the articulations in pain and contributes to a higher feeling of comfort. Before beginning any physical exercise program, people diagnosed with SaS should under go a sports medical evaluation, collecting information from both general practitioner and rheumatologist specialist. The advantages of sport activity for a rheumatic patient are seen on bones and muscles and articulations and on the efficiency of the cardiac pump. On ROM, for example, stretching, dance, gymnastic can help maintaining normal joint motion, maintaining or increasing flexibility, and reducing rigidity. Works show that aerobic exercise can reduce inflammation on some articulations. On increase and/or maintenance of muscular strength in which stronger muscles contribute in sustaining and protecting articulations affected by arthritis (for example weight lifting). On cardiovascular form, on body weight and on general comfort with aerobic or resistance exercises (for instance, walking, biking, swimming). It is known that the certification is issued in relation to the actual health, but in the same examination the physician should check the whole medical documentation and request instrumental and blood tests, together with expert advices useful to obtain a clear picture. It is known that the delay between onset of the illness and diagnosis is over 5 years. SaS usually arises from the 20th to the 40th year of age, the typical age for competitive sport activity. SaS is even more severe in males, regular attendees to Sport Medicine Centers.

Women – I have been following for 20 years female soccer teams – have a less severe spinal engagement, but are more symptomatic in regards to the interest of hips, knees, ankles and wrists We moreover remember that SaS arises in very different ways and this makes difficult the functional evaluation, the monitoring of the curse and the prognosis , therefore also the prescription of the exercise.

The curse varies as per:

1) Axial involvement
2) Peripheral involvement
3) Involvement of enthuses
4) Extra-articular manifestations such as uveitis, hypokinetic arrhythmias, etc.

Sport physician has to know the diagnostic criterions and, in case of doubt, has to immediately direct the athlete to a rheumatologist.
The best known outcome for Ankylosing Spondylitis are the following: Activity Of Illness BASDAI, VAS pain PHYSICAL FUNCTION BASFI, BASMI, DFI, HAQ-S GLOBAL HEALTH BAS (5).
The health checks in a the suitability evaluation are a general medical examination urines anlysis, electrocardiogram both at rest and under stress, spirography and, depending form which area is concerned, specific exams can be added: ORL exam, neurological examination, eye exam, EEG. At the end of the evaluation the physician gives a declaration of suitability or of non suitability for competitive practice of the particular sport, which is binding with a precise diagnosis and is notified to the athlete, to the sport club, to the Federation and to the Regional Department. The athlete has 30 days to appeal against such declaration through the Regional Committee. Within CONI there are at most 100 National Federations together with 15 Corporations which promote sports. Sports are classified in aerobic, anaerobic, mixed and dexterity. Sport physician when confronted with a rheumatic patient has to answer the following questions:
1) Is the suitability of competitive practice for that specific sport going to worsen the curse of the illness?
2) Which sport activity, competitive or non competitive, is going to improve the curse of the illness?
3) Is it possible to SUSPECT an initial stage of SA during the suitability evaluation?
4) Can the use of cortisone-based medicines, or of other medicines included in the list of doping substances, be suspended or substituted, and which are the effects of such medicines on performance?
5) Which criteria are to be used for granting a suitability declaration?
6) Suitability declaration can be given for a 1 year or 6 months time?
The aim of this presentation is to answer to these questions.

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6. Susanna Maddali Bongi, A Del Rosso. Come si prescrive l'esercizio fisico in reumatologia
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Rehabilitation strategy for shoulder ligaments instability

Domenico Creta
Servizio di Fisiokinesiterapia e Riabilitazione Casa di Cura Madre Fortunata Toniolo, Bologna
Day Hospital Riabilitativo Casa di Cura Santa Maria Maddalena, Occhiobello (RO)

There are several physical and clinical conditions that can lead to gleno humeral instability; the post traumatic instability with one direction instability (TUBS), the acquired instability by ripetititve microtrauma (AOIS) and the multi directional instability (MDI) that can more easily appear in patients with multi directional laxity (MDL). Even if several athletes are capable to adapt to a moderate laxity associated with mild instability, it can be more difficult to adapt and

come back to sport after a single post traumatic event or ripetitive gleno humeral sub luxation episodes. The normal biomechanical pattern of the gleno humeral and scapular thoracic joint is linked with the presence of coordinated and balanced forces that have to manage to stabilize articulations at any angle during joint position during movements. This forces can be compressive forces to stabilize and center the humeral head into the glenoid rim or can be translational forces and may destabilize the gleno humeral joint. The episodes of articular luxation reduce the ability of both the passive stabilizers (ligaments, capsula and glenoid labrum) and the active stabilizers (muscles) to center and stabilize the gleno humeral joint. On the other hand, muscles can determine situations of joint instability; if forces with anterior direction arise and compressive forces decrease the gleno humeral stability decreases. If the pectoralis major muscle and the muscle latissimus dorsi are to strong they can determine the anterior translation of the humeral head during the active abduction of the shoulder. The rehabilitative program should maximize reinforce of the muscles that stabilize the gleno humeral joint expecially at the mid range of movement, where the passive stabilizer have low tension. It is necessary, since the very early rehabilitative phase, to train the kinetics chain and to recover a good scapular thoracic rhythm to maximize the rotator cuff activation and strenght and this aspect is very important expecially in patients that perform sport “over head”.
In conclusion the principles to define a correct rehab treatment for all this different clinical situations of gleno humeral instability are:
the rehabilitation strategy has to be “custom made”;
the rehab program as to be “accomodating”: we have to modify the rehab work in relation to the real clinical conditions so that we can increase or decrease the activity in relation to the biological time and the patient healing response;
- the rehab program has to be “functional oriented”: the trauma and the post operative time, since the beginning, are oriented to obtain the best possible recovery in the shortest possible time, and functional activities and sport specific gestures and skills are trained, with increasing difficulties, to recover coordination and neuro motor controll necessary to let the patient to safely come back to sport;
- the rehab program has to be “a reconditioning program” to avoid muscular and sistemic fatigue, to train the cardio circulatory and the metabolic system, both necessary to mantain over the time an high level performance during the sport activity and prevent re-injury.

Effectes of exercise on rat myotendinous junction ultrastructure

D. Curzi[1], S. Burattini[1], S.Salucci[1], M.Marini[2], F. Esposito[3], A. Veicsteinas[4], E. Falcieri[1,5]
[1]DiSTeVA, Urbino University “Carlo Bo”, Urbino
[2]Department of Histology, Embryology and Applied Biology, Bologna University, Bologna
[3]Institute Physical Exercise, Health and Sport Activities, Milano University, Milan
[4]Center of Sport Medicine, Don Gnocchi Foundation, Milan
[5]IGM-CNR, Rizzoli Orthopaedic Institute, Bologna

Myotendinous junctions are specialized sites of muscle-tendon interactions and muscular force transmission from myofibrils to the collagen fibrils. The interface between muscle cell membrane and extracellular matrix at the MTJ is highly folded and interdigitated, an adaptation for reduction of mechanical stress on the junctional membrane (1,2). The aim of our work is to examine exercise-induced ultrastructural changes in the MTJ of rat *extensor digitorum longus* (EDL) muscle. In the present investigation, 24 male albino Sprague-Dawley rats, aged 9 weeks, were used. After 1week of acclimatization, 12 rats were randomly chosen to run on a six-lane rodent treadmill 1 h a day, three times a week, at 10% grade slope. The speed was gradually increased to reach 25 m/min in 5 weeks, which corresponds to ~60% *V*O2max (3), then was maintained constant for a further 5 weeks. Control animals were placed on a non-moving treadmill during the training sessions. At the end of the 10-week training, six rats, randomly chosen from control and trained animals, were immediately killed (4).
EDL muscle fragments were withdrawn, quickly fixed with 2.5% glutaraldehyde in 0.1 M phosphate buffer and maintained under tension with pins, during fixation. The specimens were successively reduced in small strips, post-fixed with 1% OsO4 in the same buffer, dehydrated with alcohol, and embedded in araldite (5). Thin sections, stained with uranyl acetate and lead citrate, were analysed with a Philips CM 10 electron microscope (6).
As supposed, observations indicate that changes in the MTJs occurred as an adaptation to exercise-induced tension increase at ultrastructural level too (7). Tension at the junctions is indeed lower during rest than exercise, so in the last condition it acts as a shearing force for the junction. The branching of the finger-like processes allows contact areas to increase, which leads to enlarge the whole tendon-muscle surface area, therefore better resisting to the tension.

The MTJ can then adapt to the shearing force, if needed, by increasing muscle-tendon branch number and their distribution complexity (8). Further studies are in progress to characterize these features by immuno-cytochemical and proteomic approaches.

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Anterior cruciate ligament reconstruction with quadrupled semitendinosus tendon

Di Feo F[1], Taurisano G[1,2], Zaytseva E[3], De Luca B[1]
[1]L. Di Liegro Hospital,
[2]Tor Vergata University,
[3]La Sapienza University

In the reconstruction of the anterior cruciate ligament, as in all techniques is essential to decrease the morbidity in the donor site with the same results.
From this point of view the use of semitendinosus only as noted by Rosenberg for the semitendinosus quadrupled and Staehelin, and Morgan for the tripled guarantees of robust if we consider that the semitendinosus has a single bound 70% of the original ACL. The removal of the tendon gives rise to a transplant length between 21 and 32-33 cm depending on the height of the subject, the skill of the operator, and a imponderable variable bound at cut from the tendon stripper teno-muscular junction.
The purpose of this study was to determine the results at three years of primary anterior cruciate ligament (ACL) reconstruction with quadrupled semitendinosus tendon (femoral endobutton and tibial resorbable screw) and ad accelerated rehabilitation protocol.
One hundred patients who had undergone an ACL reconstruction for an anterior cruciate ligament tear with quadrupled semitendinosus tendon (from 2002 to 2007) were included into this study. In order to achieve a homogeneous cohort we determined the following exlusion criteria: patients with meniscal lesion that required refixation because a different rehabilitation protocol, patients with collateral ligament lesion more than grade I, patients with surgery in the first 2 weeks following the trauma, patients with pcl and/or posterolateral lesions.We used a standardized surgical technique modified from the original described by Rosenberg. The semitendinosus tendon was harvested and prepared as a quadrupled graft. Arthtroscopy was performed an meniscectomy if necessary. The tunnes are drilled, the same diameter of the graft, in the tibial footprint of acl and at 10,30 or 1,30 position for the femoral half tunnel. The graft fixation was performed at the femoral side with cl and at the tibial side with a reabsorbable screw diameter 1 mm more than the graft.
All patiens undergone a standardized acl rehabilitation protocol as described by Shelbourne.
Patients underwent a standard knee examination with Lachman test and jerk test, range of motion at 6 months and 3 years.
At the final follow up ninty-two patients are available.
patients (92%) are fully satisfied, 80 (86%) patients returned to sports at the same level 6 (6,5%) patients had a Lachman test and jerk test full positive.
2 patients have deep infection of the knee and were treated 1 with artroscopy and 1 with oral antibiotics alone: at three years this patients are fully satisfied and returned to sports.
4 patients have limited range of motion (5 -12%) and are not satisfied despite a very stable knee.
The above data show minimal morbidity, a low reoperation rate, and excellent clinical outcome. Because the stability of the knee persists beyond 4 years after ACL reconstruction, patients are able to maintain preinjury activity levels without reinjury.
Midterm results obtained in this study after arthroscopic ACL reconstruction with the quadrupled semitendinosus tendon confirm the outcomes in the literature after shorter follow-up periods that provide very good and good subjective,

functional and stability results in about 80-85% of the patients. This surgical technique can be recommended for the active patient with ACL deficiency.

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Revision ACL surgery using DGST graft

A. Ferretti, F. Conteduca, E. Monaco, L. Caperna
University of Rome La Sapienza, II school of Medicine
St Andrea Hospital, Kirk Kilgour sports injury center

The anterior cruciate ligament reconstruction is one of the most common orthopaedic surgical intervention (1-3). The purpose of the reconstruction is to restore knee stability and function, giving the patient the possibility of a return to sport activity. Over time we have seen an evolution of the surgical techniques and of the fixation devices leading to an overall improvement of the final outcome but, over time, for many reasons a failure may occur. Failure rate of primary ACL reconstruction range from 5% to 25% as reported in literature (2, 4, 5). Causes of failures may be traumatic or atraumatic. The most reported cause of failure is an error in the surgical technique (6) that can be a tunnel improperly placed, too anteriorly in the majority of the cases (7-9), or an error in the tunnel orientation. As traumatic causes they can happen in the early phases of the rehabilitation and so that failure may be due to the fact that the graft integration is not yet completed, or it can happen as a new trauma with a force similar to the first episode. The prevalence of failure is difficult to determine because of a lack of uniformity in the definition of a failure. We define failure as a recurrent laxity (side to side laxity in excess of 5 mm or a grade 2+ or greater on pivot shift testing). When a failure occurs it may lead to a knee instability, in daily activities or during sports. In that cases a revision surgery can be performed to restore the knee stability. Other symptoms like recurrent swelling or knee pain are not direct indication to a revision surgery.
In a previous study we showed the early results of ACL revision surgery using autologus doubled semitendinosus and gracilis tendon (DGST) graft with the addition of an extrarticular reconstruction and we explained our surgical approach (10).
All of the patients in our study had knee pain and instability during sports and daily activities and instability on objective evaluation.
Most studies examining the outcome of revision ACL reconstruction have been performed on patients reconstructed with autologous (11-13), allogenic (14), or reharvested bone–patellar tendon–bone grafts or included subjects with a variety of graft constructs. The results of revision ACL reconstruction published in the current literature are difficult to interpret because of lack of standardized fixation methods, surgical techniques, graft types, and concurrent operative procedures. We present the results of revision ACL reconstruction in a series of 46 patients, all of whom underwent reconstruction with a quadrupled hamstring tendon autograft performed by a single surgeon with standardized operative technique, graft fixation methods, and postoperative rehabilitation reviewed at a mean of 6 years' follow-up.
The most common etiologic factor in failures of anterior cruciate ligament reconstructions is considered to be an error in surgical technique—i.e. (6-9, 15), improper intra-articular placement of the graft with impingement of the graft in the intercondylar notch, improper tensioning of the graft, or inadequate graft fixation. However, such errors are not always recognized during revision surgery. The failure of the ACL reconstruction may also be traumatic. If we have an

early trauma the failure may be caused to the fact that the graft integration is not yet completed (15). Also a premature return to sports is a well documented cause of failure. A later trauma may require a force similar to the first episode to have a rupture of the graft. In our study we found in 26 patients an error in the surgical technique during the primary reconstruction, in 13 patients we had a new trauma and in 4 cases we had the rupture of a prosthetic ligament. In our experience the most common surgical error is the Non-anatomic femoral and tibial tunnel placement. That is report also widely in literature (2, 15, 6-9). Surgical revision of a failed anterior cruciate ligament reconstruction requires thorough preoperative planning (20) and evaluation of the factors that may have caused the failure so that these problems can be addressed during the revision operation. The evaluation should include a radiographic examination to evaluate the orientation of the tunnels (and any possible enlargement of them) and the type of preexisting fixation devices. Other factors that could result in a two-stage procedure, such as the type of graft used in the primary reconstruction and the site and type of fixation devices utilized, should also be assessed. The compliance of the patient must be evaluated. In fact revision surgery is often considered to be a salvage procedure (11, 12) with limited goals, such as restoring stability to allow work activities of daily living, and light recreational sports.

We perform in every patient a preoperative radiographic evaluation to study that tunnel positioning, tunnel widening, the type and the position of the fixation devices and the state of the cartilage. So that when we perform the revision surgery we are alarmed by every possible factor that may cause a later secondary failure or require a 2 stage procedure. In our experience the most common reasons for performing a 2 stage revision were bone tunnel enlargement, problems encountered with the removal of pre-existing devices and ostheolisis around the tunnel. Specifically in 3 patients the removal of pre-existing devices would have resulted in bone disruption of either the tibial or femural condyle and the revision was performed in a single stage with these device left in situ. In literature it seems like the most used graft, both for primary reconstruction and for revision surgery, is the Bone-patellar-bone tendon (5, 16) and the debate regarding the most suitable graft source for revision ACL reconstruction remains contentious but the bone patellar -tendon- bone and the quadrupled hamstring tendon autografts have both been shown to have acceptable results. Noyes at al. (11) reported good results using BPTB with a graft failure rate of 24% of the patients that underwent revision surgery. Another graft that is commonly used in literature is the quadriceps tendon. Garofalo et (12) al. showed a patients satisfaction of 93% at a 4.2 years follow-up after a revision surgery performed with quadriceps tendon. Our first choice for primary and ACL revision is the use of autologus hamstring tendons graft. We apply to a revision surgery an approach similar to the one that we use on a primary reconstruction. That is based on 4 key points: the use of Hamstring and semitendinosus tendons as the graft choice, the use of an extrarticular reconstruction, evolgate and Swing-bridge as fixation devices and an unaggressive rehabilitation protocol. If we consider failure in this series to be additional revision surgery, a side to side difference of more than 5mm at manual maximum kt-1000 testing or a grade of 2+ or higher on pivot shift our failure rate would be 3 out of 46 patients (6,5%). The results of our study are comparable, if not better, of the ones founded in literature (2, 11-14) on different kind of grafts or fixation devices. Patients had a good return to sport activity with 90% of the them that are able to perform most of the sport activities in contrast to some authors that reports a loss of sport activity at the follow up with only 56% returning to an unrestricted sport level or only 36,4% of patients returning to a pre-trauma level (2). Only few patients complained about minor problems and only 3 patients were not truly satisfied with the operation. Overall we can say that the results of our revision surgery are similar to the ones we obtained with primary surgery. That is in contrast with the majority of the authors. In case of bone tunnel widening the key for a successful hamstring revision is appropriate fit and fill in its host tunnel, therefore the problem with the revision ACL surgery with DGST seems to be secure fixation of the graft in the tunnels. As reported also by other authors (14) the fixation devices play a fundamental role. In our series we had 4 two stage revisions all occured using staples on tibial side. However we overcome this problem with a strong and stiff fixation especially on tibial side. Infact since we started using evolgate for the tibial fixation we had no more 2 stage procedures. The evolgate, has a metal spiral inside the tibial tunnel that reinforces the walls of the tunnel to avoid the loss of fixation strength related to the low density of the cancellous bone of the proximal epiphysis of the tibia (18) or to a bone loss in case of tunnel widening. In these cases it is possible to apply bone plugs to reinforce the walls in association with the spiral of the evolgate to improve the fit and fill of the tendon so that it is possible to perform a 1 stage revision. Moreover on the femoral side the swing-bridge also is a strong fixation device due to the fact that it has a cortical grip which can be useful in case of tunnel widening. There are no clear data in literature reguarding whether or not a 2 stage revision surgery brings better results (13,19). We found that when we perform a 1 stage revision we achieved really good results. So we do really believe that there is not the necessity of a second stage especially using appropiate fixation devices. The two-incision technique that we use seems like a good choice, especially when a half tunnelled technique was used in the primary reconstruction or when a blow-out of the posterior cortical wall was encountered. In fact, the outside-in technique allows the surgeon to orient the femoral tunnel in such a way that the new graft can be fixed in a previously undrilled area. The role and effectiveness of a lateral extra-articular procedure performed in association with the anterior cruciate ligament reconstruction have not been defined (19). While some authors have expressed the belief that postoperative stability cannot be improved by any additional procedure, others have reported better results when an extra-articular iliotibial band tenodesis was performed in association with an intra-articular anterior cruciate ligament reconstruction, especially if a semitendinosus and gracilis graft was used (19).

When we perform a primary anterior cruciate ligament reconstruction (20), we use a modified Macintosh lateral tenodesis with an intra-articular doubled gracilis and semitendinosus tendon graft reconstruction only to treat severe chronic rotatory instability (a 3+ pivot shift test). We believe that the extra-articular reconstruction can protect the graft from excessive, undesired stresses during the early postoperative period and thus it would be useful in revision anterior cruciate ligament surgery. Some authors consider acceptable the use of an accelerated rehabilitation program after anterior cruciate ligament reconstruction. It is well know that a secure tendon-to-bone healing requires at least twelve weeks. A fast rehabilitation can create an excessive stress, in the form of micromotion of the graft, and that can slow the biological healing. Even if we use strong fixation devices, and especially because we use hamstring tendons we think that in primary reconstruction and especially in revision surgery it is better to use a slower rehabilitation program.

Several studies have demonstrated a correlation between cartilage damage and meniscal tears and the clinical and radiographic outcomes of both primary and revision anterior cruciate ligament surgery (21). In this study 45% patients have not shown degenerative changes joint disease at the time of follow-up. However only 25% of patients with a longer term follow-up showed no sign of joint degenerative disease so the follow-up lenght seems to be the major factor related to the DJD. When a patient has substantial articular cartilage damage, the goal of the operation perhaps should be to decrease instability with activities of daily living and possibly allow a return to light recreational activity.

The results suggests that using hamstring tendons as graft choice is more than suitable for a revision surgery. Strong fixation, a short rehabilitation program, the use of an extra-articular reconstruction are aids to the revision and should to be considered. However patients should be informed that, despite the achievement of a stable knee following reconstruction, degenerative joint disease frequently occurs at a long time follow-up.

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Preclinical studies on an acellular allogenic collageneous membrane in view of the clinical application for rotator cuff tendon regeneration

M. Fini, E. Bondioli, R. Giardino, D. Melandri
Laboratory of Preclinical and Surgical Studies and Laboratory of Biocompatibility, Advanced Therapies and Technological Innovations, Rizzoli Orthopaedic Institute, Bologna-Italy Burn Intensive Care Unit and "Regione Emilia Romagna" Skin Bank, Bufalini Hospital, Cesena, Italy

Tendon and ligament injuries are very frequent in the general population with high health care costs and patient morbidity. The rotator cuff of the shoulder is one of the most commonly injured soft connective tissues, and to avoid patient disability, surgery using primary repairs, autografts, allografts, xenografts and synthetic biomaterials has been attempted. However, the treatment of massive rotator cuff tears is still a major challenge in shoulder surgery. Scaffold selection is of extreme importance for the success of the tissue-engineered techniques and biological ECM materials is gaining interest because proteins and growth factors native to the ECM materials can modulate host cell adhesion, migration, proliferation and synthetic activity and, consequently, accelerate the biology of tissue repair (1, 2). Different commercially available biological ECM materials exist and include ECM from dermis, small intestine submucosa, pericardium and fascia lata from different origins (human, porcine, bovine, equine) (3-8). ECM source and origin, proper processing techniques strongly affect biological and mechanical characteristics of ECM matrices. The present research is aimed at evaluating biocompatibility, bioactivity and biofunctionality of a collagenic decellularized dermal matrix (HDM) that was developed by means of a chemico-physical methods from multi organ and multi tissue donors by strictly following existing rules on explanted tissue processing and distribution of National and Regional Transplantation Centres.

After tissue procurement, research was aimed at the development and characterization of the decellularization technique and the assessment of HDM cellularity, morphology, bioactivity, biomechanical properties and *in vivo* biocompatibility! For these purposes, MTT cell viability tests, residual DNA content me asurement, glycosaminoglycan (GAG) and collagen determination, histology (Hematoxylin and Eosin and DAPI), immunohistochemistry, transmission electron microcopy (TEM), were performed. GF release was measured on membrane extracts and with cell proliferation induction tests. *In vitro* test with tenocyte cultures were performed and at 3 and 7 days viability (MTT), collagen I (CICP), proteoglycans (PG), fibronectin (FBN), TGF-b1and IL6 were measured. An *in vitro* wound healing model (9) was used to evaluate HDM bioactivity and decorin synthesis and the healing time were monitored at 1, 4, 24 and 72 hours. Tensile strength analysis was performed to evaluate biomechanical characteristics of HDM. Finally, tissue response was analyzed by subcutaneous implantation in rats and subsequent histological and histomorphometric studies.

MTT vitality index of decellularized HDM ranged from 0 to 1.8%. Histological examination showed absence of visible cells. The DAPI staining and TEM analysis confirmed absence of cell nuclei and double strand DNA in the decellularized membranes. Tissue architecture was normal and collagen fibers had large bands with normal morphology, and elastic fibers were preserved in large amounts and showed signs of fragmentation in some areas. Pico-Green analysis for residual DNA content showed that the native dermis had 1.38 ± 0.45 μg/mg of DNA which was reduced to 0.20 ± 0.12 μg/mg after decellularization (decellularization yield 85.6%, $p<0.0005$). Extracellular matrix proteins, such as GAGs and total collagens, were preserved following decellularization, without significant differences before and after decellularization. Among GFs, TGF-β1 showed the highest concentration preserved with the decellularization protocol. VEGF and PGDF-AB decreased significantly after decellularization. Interleukin-1β was not detected before and after the decellularization technique. L929 fibroblast proliferation, with or without extracts, was assessed by WST1 tests at 24 and 72 hours. HDM extract significantly enhanced proliferation of cultured fibroblasts at 24 (16%, $p < 0.05$) and 72 (51%, $p < 0.0005$) hours in comparison with controls cultured without extracts. A significant higher amount of

collagen I was observed when tenocytes were cultured on HDM in comparison with controls (3 days: $p < 0.0001$; 7days: $p < 0.05$). In HDM group, FBN synthesis was significantly higher at both experimental times ($p < 0.0001$). At 3 days, PG and TGF-β1 were significantly higher when tenocytes were plated with HDM ($p < 0.0001$; $p < 0.005$). The healing time of artificial wounds as well as decorin expression resulted significantly enhanced by the addition of 50% HDM extract ($p < 0.05$). Maximum load and stiffness of HDM were significantly higher than those of cellularized dermis (115%, $p < 0.005$ and 122%, $p < 0.005$, respectively). *In vivo* data showed the presence of a thin fibrous capsule that consisted of fibroblasts and small inflammatory cells immersed within moderately dense collagen fibers oriented parallel to the long axis of implants, and new vessels. Poor inflammatory cell infiltration was detected around the membranes, which diminished significantly over the experimental times. In fact, significant decreases in cell infiltration were found between 7 and 90 days ($p < 0.005$) and between 30 and 90 days after surgery ($p < 0.05$). No giant cells were observed at each experimental time, while fibroblasts and adipocytes were observed inside HDM membranes at longer experimental times. Occasional macrophage infiltration was found within HDM membrane at each experimental time.
Even if more studies are needed, our results suggest that the decellularization method might allow the development of a decellularized human dermal matrix allograft that could be used for the *in vitro* and *in situ* tissue regeneration with particular interest for tendon tears. The decellularization protocol seems to be a good balance between removing cellular elements and preserving matrix integrity from a structural and biological point of view.

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Mechanical Vibration and Mio-Capsulo-Ligament Unit

Calogero Foti
Physical and Rehabilitation Medicine Chair, Health Department, Tor Vergata University, Rome, Italy

Many scientific studies argue that vibrations induce together metabolic and mechanical adaptive responses of the human body (1-3). Indeed mechanical factors hold an important role in human adaptive response, as they improve muscular functions and increase bone regeneration process by stimulating the muscle and triggering osteoblasts. Vibration are shown to be a powerful activation stimulus for the whole neuromuscular and skeletal system. The vibration energy begins to be considered either as a therapeutic exercise as well as a physical mean applied directly on the body surface.
The aim of the study was to assess the efficacy of local vibration treatments in delayed-union and non-union fractures, through a therapeutic exercise vibration (TEV) practice, by analysing the radiological trend. This is a case of a 42-years-old man who had a multiple right tibia fracture following a car accident on july 2005. He was undergone a fracture reduction operation by osteosynthesis as rings and plates at 1/3 right tibia distal level. On july 2009 a right leg CT evidenced a non-union fracture, a pseudoarthrosis diagnosis was made. The TEV application was based on a four week training scheme with five weekly treatments organised as follow: daily treatments of 6 sets, 5 repetition each; each repetition at 35 Hz for 30 seconds; 60 seconds pause between repetition; 90 seconds pause between sets; application of handpiece on the heel. For the evaluation of the treatment and assessment of the local vibrations (LV) efficacy in non-union fractures, three radiographs were performed at different times: one in admission, one at discharge and one at follow up, 60 days after the end of treatment. Clinical and radiological aspects are integrated by the administration of rating scales for pain (Mc Gill Pain questionnaire) and functional evaluation (Barthel Index and LEFS - Lower Extremity Functional Scale). The results of the cirtometer show a difference of 1 cm around the malleolus and at 10 cm above the medial malleolus indicating a reduction of the perilesion edema. The LEFS Scale and the Barthel Index show respectively an increase from 31/80 to 46/80 and from 98/100 to 100/100 before and after treatment. Furthermore, algic symptomatology decreased as shown by the McGiLL Pain Questionnaire results from 25/60 before

treatment to 10/60 after treatment. The radiographic image performed at entrance (23/09/09) shows some of the characteristic radiological features of non union fractures. The radiographic image taken at discharge (30/10/09) shows the presence of a “nubecola” at fracture line expression of biological activity in progress. The radiographic image at follow up, 60 days after the end of treatment (16/01/10), shows an increase of the “nubecola” already highlighted at discharge, reflecting persistence of biological activity, with appearance of osteoreparative event at fracture line. The results reported in the clinical study, confirm that therapeutic exercise vibration associated with normal rehabilitation treatments, is a great contribution in the treatment of pathological disorders of bone rigeneration, by resolving delayed union consolidation or greatly reducing the time of recovery.

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Tendon fibres, peritendinous tissues and muscular sheaths responding to tensional forces

Marco Franchi, Viviana De Pasquale, Desirè Martini, Vittoria Ottani
Dipartimento di Scienze Anatomiche Umane e Fisiopatologia dell’Apparato Locomotore, University of Bologna, Italy

The major functional component of tendon extracellular matrix in transmitting forces from muscle to bone to favor joint movements and locomotion is type I collagen which represents more than 70% of the tissue solid phase. Collagen type I is hierarchically arranged in microfibrils, fibrils, fibres and fibre bundles which are mostly unidirectionally aligned along the main axis of the tendon. However tendon collagen fibres when observed at the light polarized microscope show a periodic sinusoidal waveform or crimps which are formed by single fibrils that sharply change their direction at the apex of each crimp and show particular fibrillar knots or fibrillar crimps observable only at the transmission and scanning electron microscopes (1). Crimps composed by fibrillar crimps seem to act as biological hinges which contribute in absorbing initial tension during tendon elongation and recoiling fibrils when tendon relaxes (2).
In skeletal muscle the tendon is continuous with both the muscular sheaths, epimysium and perimysium. It was suggested that forces from the muscle fibers contraction could be also transferred via lateral transmission between neighboring intramuscular collagen fibres and fascicles to tendon and peritendinous tissues (3). Like tendons, peritendinous tissues and other connective sheaths containing both type I and III collagen have been reported to show crimp-like structures at the light polarized microscope. The aim of this study was to relate the collagen microfibrillar and fibrillar arrangement to the fibril mechanical function exerted in tendons, peritendinous tissues and intramuscular connective tissues with particular attention to the function of the fibrillar crimp structure analyzed by polarized light microscopy, scanning electron microscopy and transmission electron microscopy.
Twelve Sprague-Dawley rats (90 days old) were killed by Pentotal injection. Tail tendon, Achilles tendon, flexor digitorum profundus tendon with their peritendinous tissues, flexor digitorum profundus and gastrocnemius muscles containing intramuscular connective sheaths, aponeurosis of the linea alba and fascia communis were removed immediately after animal death. Some specimens were fixed overnight in 10% buffered formalin, dehydrated in graded concentrations of alcohol and embedded in paraffin for polarized light microscope (PLM) analysis, whereas others were briefly fixed in 1% glutaraldehyde plus 1% paraformaldehyde in 0.1M cacodylate buffer (pH 7.2), dehydrated in graded ethanol and then processed for scanning (SEM) and transmission (TEM) electron microscope observations.
At PLM all tendons (tail tendon, Achilles tendon and flexor digitorum profundus tendon) appeared composed of straight and parallel collagen fibres showing alternating dark and light bands corresponding to the described tendon crimps. The longitudinal distribution of crimps, appearing as isosceles and scalene triangles, their size and top angle varied from tendon to tendon. At PLM tendon sheaths, aponeurosis of the linea alba, fascia communis and intramuscular connective sheaths of flexor digitorum profundus and gastrocnemius muscles showed thin collagen fibre bundles following a wavy arrangement and exhibiting crimp-like structures.
At SEM and TEM observations collagen fibrils of all tendons exhibited a bimodal large diameter (60-300 nm) and running parallel in flattened helices showed the characteristic knots or fibrillar crimps at the apex of each crimp. Differently, collagen fibrils of peritendinous and intramuscular connective sheaths or aponeurosis tissues showed a small

uniform diameter (25-100 nm) and followed a sinuous/helical course with different degree of curvature but no fibrillar crimp or knot was detectable.
Collagen fibrils of peritendinous tissues, intramuscular sheaths and aponeurosis presumably submitted to pluridirectional forces, show an unimodal small diameter (25-100 nm) and a helical microfibrillar array of 17° with respect to the fibril axis and a 64-nm D-periodicity. At the morphological investigations they appear extremely flexible as they can accommodate extreme curvatures without harm, never showing fibrillar crimps. By contrast, the thicker fibrils (100-300 nm) of tendons submitted to unidirectional loadings show a microfibrillar winding array of 5° and consequently a 67-nm D-periodicity (4). They appear structurally and mechanically more rigid and cannot suddenly bend without structural deformations like the fibrillar crimps. The constant left-handed path of tendon fibrils always observed in the fibrillar crimp region gives rise to left-handed fibril helices (5). The leftward twisting and bending of fibrils give rise to fibre flattened left helices acting like biological hinges and previously described by some authors as planar crimps. The shock absorption and tendon recoil function of the fibrillar crimp system seem to be related to the diameter and in particular to the microfibrillar arrangement of the fibrils. Fibrillar crimps and their mechanical functions are distinguishing of the tendon thick fibrils.

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Clinical aspects of rheumatic enthesitis

Luigi Frizziero
Division of Internal Medicine and Rheumatology Centre, Ospedale Maggiore, Bologna, Italy

Enthesitis is an inflammatory condition at the site of insertion of a tendon, ligament, or joint capsule into a bone and is now accepted major clinical manifestation and pathology of spondylar-tropathies (SpA). Imaging information has changed the conceptual understanding of enthesis. Entheses can be understood not merely as focal attachments of tendons or ligaments, but as part of an “enthesis organ complex”, that can dissipate stress concentration away from the attachment site at the bony interface (1). Entheses form biologic interfaces that link soft tissue and hard tissue boundaries: due to their location at sites of mechanical challenges, entheses are prone to overuse injuries: tennis and golfer’s elbow, jumper’s knee and achillopathies are well-documented pro-blems in sport medicine. Historically enthesitis has been viewed as a focal insertional problem of soft tissue, but the inflammation also affects the bone, because osteitis adiacent to fibrocartila-ginous entheses or next to fibrocartilaginous synovial joints is a characteristic feature of SpA (2). The fundamental difference between SpA and rheumatoid arthritis is that SpA is enthesis-based pathology (3). Enthesitis is clinically manifest by the onset of spontaneous pain and tenderness upon pressure or in obstructed movement. The clinical assessment is challenging because these structures are not often visibly inflamed. They can not be located deep within surrounding tissues, and they are often contiguous with synovium. Therefore, a reliable and accurate instrument must not only localize the enthesis anatomically, but also distinguish it from other forms of joint inflammation (4). The clinical evaluation is predominantly performed by applying pressure on entheses to elicit tenderness at these sites. Several outcome measures have been developed to assess enthesitis**.** Mander (5) proposed an enthesitis index (MEI) to investigate enthesitis in ankylosing spondylitis, grading tenderness to palpation of 66 entheses on a 0-3 scale. A new concise method, namely the Maastricht Ankylosing Spondylitis Enthesitis Index (MASES) evaluates from 66 to 13 entheses; most are distant from peripheral joint (except Achilles tendon insertion), which reduces the risk of confounding peripheral arthritis pain (6). The Canadian Spondyloarthritis Research Consortium (SPARCC) published a method that assessed enthesitis at 4 paired sites, plantar fasciae, Achilles tendons, tibial tuberosities, and rotator cuff insertions, but observer agreement was moderate to poor (4, 7). However the rate of clinical detection of peripheral enthesitis is frequently inconsistent, and the role of imaging has taken an increasing importance. Enthesitis-related changes can be visualized on plain radiography, but it frequently fails to show enthesitis in its early phase. MRI and US have been used increasingly in this regard (8). US has been reported to be better than clinical examination in detecting

enthesitis of the lower limbs in SpA, actually using PDU a distinctive pattern of abnormal vascularization adiacent to entheses (9). US is the method of choice because it is capable of detecting both the early and late alterations; it is also an inexpensive, repeable technique. Signs suggestive of enteseal inflammation are alterated vascularization, thickened tendon insertion, fusiform swelling of the tendon or ligament, calcific deposits, para-tendinitis, erosions or periostitis of adjacent bone, and loss of the normal fibrillar pattern of the enthesis that occurs with edema (9-11). MRI changes seen in enthesitis include soft tissue swelling, distention of the bursa with fluid, and bone marrow edema near the insertion site (12). Recent studies show that imaging techniques such as MRI, US or scintigraphy are superior to clinical examination, and some asymptomatic enthesitis might only be detectable by imaging techniques ((8, 12**).** A significant correlation of PDUS grading of enthesitis and MASES, indicates that pain or tenderness are related to increased vascularity of the enthesitis (13). Enthesitis other then a typical clinical feature of SpA has been seen as a focal insertional disorder. Imaging studies performed with MRI and US have challenged this view. In patients with SpA not all entheses are similarly affected: inflammatory changes of entheses may occur mostly at sites of repeated mechanical trauma. Mechanobiology has emerged as an intriguing concept from which we probably have not yet learned all consequences (14). The central importance of the enthesis in understanding the pathophysiology of inflammation in the SpA has been aided by the development of the “enthesis organ concept”, which explains why tissues adiacent to the enthesis itself are also subject to pathologic change. Soft tissue microdamage is often accompanied by synovial changes and the presence of immune cells within the enthesis. The inflammation also affects the bone (osteitis). Biomechanical factors related to the enthesis and the wider “synovio-entheseal complex” could play an important role in the genesis of synovial inflammation. Although enthesopathies are traditionally viewed as focal, insertional disorders, finding on MRI and US suggest the presence of more diffuse changes with involvement of the adjacent bone and soft tissue. The concept of an “enthesis organ” can be applied to many tendon and ligament attachments and is central to understanding of the SpA. The “autodisplay hypothesis” offers an additional link between HLA-B27 and immunopathology. HLA-B27 might be a gatekeeper for autoimmunity by presenting arthritogenic peptides. Furthermore, HLA-B27-derived peptides could act as autoantigens as well (14). The inflammatory involvement of the entheses, a characteristic feature of SpA, is undervalued in the effort to improve the early diagnosis of SpA. In this sense, a non-invasive test would be desirable. Peripheral enthesitis produces pain but may also be asymptomatic, and the clinical examination lacks sensitivity and specificity, as has been demonstrated by several studies comparing clinical evaluations with new imaging techniques (15). To date, MRI and special US have remained the most accurate imaging techniques for assessing enthesis inflammatory processes. If enthesis is a true hallmark of SpA, and if enthesitis US is a sensible, specific and reliable tool, then US can be used to improve the accuracy of the SpA classification diagnosis. A recent gender-matched subanalysis revealed that women had significantly fewer lesions in entheses than men, including for SpA patients (16). In summary, entheses involvement occurs early in SpA, even in non-radiographic axial patients. Male gender, but not HLA-B27 positivity, was associated with a higher amount of entheses involvement. The presence of entheseal involvement was independent of SpA subtype or presentation pattern. The entheses ultrasound score appears to be valid and may be useful for improving the diagnostic accuracy of early SpA.

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Effect of training and sudden detraining on the patellar tendon and its enthesis

Antonio Frizziero[1], Milena Fini[2], Francesca Salamanna[2], Arsenio Veicsteinas[3], Nicola Maffulli[4], Marina Marini[1]

[1]Department of Medical and Surgical Science, Center of Orthopaedic Rehabilitation, University of Padova, Italy
[2]Laboratory of Pre-clinic and Surgical Studies, Rizzoli Orthopaedic Institute, Bologna, Italy
[3]Department of Sport Science, Nutritionand Health, University of Milan, and Center of Sport Medicine, Don Gnocchi Foundation, Milan, Italy
[4]Queen Mary University of London, Barts and The London School of Medicine and Dentistry, Center for Sports and Exercise Medicine London, United Kingdom

Tendon is a highly organized connective tissue, capable of resisting high tensile strength while transmitting forces from muscle to bone. The region where a tendon, ligament or joint capsule attaches to bone is the enthesis. With exercise, the turnover of mature collagen and collagen cross-links increases, large diameter fibrils are formed with increased packing density of fibrils and increased tendon stiffness. Exercise also leads to changes in PG content. Strenuous exercise in mature rodents orchickens leads to thickening of collagen fibrils and increase in the galactosamine-containing glycosaminoglycans (GAGs). In contrast, immature tendons respond to exercise with higher collagen turnover, reduced maturation of collagen and changes in hyaluronan concentration. Kubo et al. observed that tendon adaptation to detraining is faster than the one to resistance training, but to the present author knowledge, in comparison with training or immobilization, the effects of sudden detraining on tendons have not beendeeply investigated.
A variety of conditions, including immobilization, training, aging and medications, may influence tendon characteristics. Immobilization results in profound reduction in the mechanical properties of tendon.
Clinical evidence suggests that tendon injuries are more frequent in athletes that change type, intensity and duration of training. There is a paucity of data examining the impact that cessation of training may have on tendon. In practice, we do not fully understand how tendons respond to a period of training followed by sudden detraining.
Aim of the study was the assessment of training and especially detraining on the patellar tendon (PT) and its enthesis. 27 male adult Sprague-Dawley rats were divided into 3 groups: 20 rats were trained on a treadmill for 10 weeks. Of these, 10 rats were euthanized immediately after training (trained group), and 10 were caged without exercise for 4 weeks before being euthanized (de-trained group). The remaining 7 rats were used as controls (untrained rats). PT insertion, structure (collagen fiber organization and proteoglycan, PG, content), PT thickness, enthesis area, and subchondral bone volume at the enthesis were measured by histomorphometry and microtomography.
Both PG content and collagen fiber organization were significantly lower in untrained and detrained animals than in trained ones ($p < 0.05$ and $p < 0.0001$). In the detrained group, fiber organization and PG content were worse than that of the untrained groups and the untrained group showed a significantly higher score than the detrained group ($p < 0.05$). In the trained group, the PT was significantly thicker than in untrained group ($p < 0.05$). No significant differences in the enthesis area and subchondral bone volume among the three groups were seen.
Moderate prolonged physical activity exerts a protective effect on the tendon structure and morphology andinduces an increase of PGs. Discontinuing such activity has the opposite effects, and, in the short term, disrupts intra-tendinous tendon morphology.
The present results suggest that after a period of sudden de-training (such as after an injury) physical activity should be restarted with caution and with appropriate rehabilitation programs because cessation of activity cause modifications of PT collagen organization and PG content.

Posterior humeral avulsion of the glenohumeral ligament

Raffaele Garofalo, Enzo Vinci, Alessandro Castagna
Shoulder Unit F. Miulli Hospital Acquaviva delle fonti Ba, and Shoulder and Elbow Unit IRCCS Humanitas Institute Milan, Italy

Recently, the posterior glenohumeral avulsion of the glenohumeral ligament (PHAGL) has been reported in the orthopaedic literature as a possible cause of posterior shoulder instability or pain and discomfort (1,2). The Inferior gleno humeral ligament (IGHL) with the hammock, the anterior and posterior band plays a key role in anterior shoulder instability. We know that avulsions of this ligament and of the labrum (Bankart, Perthes, ALPSA lesion) from the glenoid have been established as primary lesions in anterior inferior instability in both clinical and cadaveric studies. Nevertheless, there is evidence that glenohumeral ligaments can fail at the humeral insertion site. Nicola at first reported this pathologic anatomic finding, which was confirmed by cadaveric dissection (3). He described the avulsion from the anterior part of the humeral head and this lesion in the 1995 was coined as HAGL (Humeral avulsion gleno humeral ligament) by Wolf (4). The reported incidence of HAGL lesions has increased with the advance of shoulder arthroscopy, suggesting that the humeral capsular insertion site could be a more frequent site for ligament failure than has been reported in the previous clinical studies, however, posterior lesions are seen as well. An avulsion of the posterior casule from the humeral insertion was at first described by Snyder which named this lesion as RHAGL (reverse humeral avulsion of the glenohumeral ligament) to indicate that was similar but opposite to the anterior humeral avulsion (5). He discovered this lesion occasionaly while viewing the posterior capsule from the anterior portal during an arthroscopic surgery for a posterior instability. In literature this lesion has been referred as rHAGL or PHAGL. The PHAGL lesion is an avulsion of the posterior capsule of the glenohumeral joint at level or above the level of the posterior band of the IGHL that may or may not extend into the posterior band of the IGHL itself. According to some authors the term of PHAGL should be reserved to the avulsion of the capsule at the level of the posterior band and not above; however this can create some confusion, so the term rHAGL or PAGHL are commonly used independenntly to indicate an avulsion of the posterior capsule from the humeral insertion. In literature this lesion has been reported as a possibile cause of posterior instability (1,2,6). However in a case series published on this lesion Castagna et al. noted that PHAGL lesion that was often associated (67% of cases) with other intra-articular shoulder abnormalities such as an anterior Bankart lesion, ALPSA lesion, SLAP lesion or a posterior Bankart (7); this last it the so called “floating band” (6). This can be a reasonable assumption if we consider the anatomy of the hammock-like structure of the IGHL with the anterior and posterior band and the “circle concept” applied to the glenohumeral joint. Recognition of the PHAGL and rHAGL lesion is very difficult overall preoperatively and requires a high index of clinical suspicion; however, specific findings are lacking and furthermore symptoms and signs can be variable because of reported associated lesions. The only clinical sign that has been found positive in many patients is a provocative test consisiting in the presence of posterior shoulder pain during forward flexion and internal rotation maneuver. About the imaging studies gad-MRI have been reported to be useful tools in detecting the PHAGL lesion (5, 8). In the series reported by Castagna et al. (7) in the 67% of patients were found findings compatible with PHAGL lesions on a gad-MRI, but, similar to other reports (2) the PHAGL lesion was identified only on retrospective analysis and never before surgical procedure. Bokor, recently reported that the 50% of rHAGL lesions were correctly identified using MRI by the reporting radiologist. The percentage increased to 78.6% when reviewed by the senior surgeon at preoperative time. The remaining 21% of patients did not demonstrate an obvious disruption of the posterior capsule on the MRI (6).

Certainly the best way to diagnose this lesion is the arthroscopy. This is the only way to adequately evaluate the posterior capsule and its humeral site of attachment. Arthroscopic sign of a PHAGL lesion is the visualization of the fibers of the posterior cuff muscle through the avulsed joint capsule, which is detached from the humeral neck and often retracted into the posterior gutter.

Treatment of the injury hinges on its recognition. Once recognized, the lesion can be treated with reattachment of the posterior capsule to the humeral neck. Several reports describe arthroscopic techniques for this reattachment with good and predictable outcome (2,7,9). Other authors, prefer an open reattachment via a small, deltoid-splitting approach, using the interval between infraspinatus and teres minor muscles, reporting as well satisfactory results (6).

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Surgical treatments in ankle instability

Sandro Giannini
Clinica Ortopedica dell'Università di Bologna, Istituto Ortopedico Rizzoli

Chronic ankle instability (CAI) after ankle sprains is commonly seen in the clinic. 80% of acute ankle sprains make a full recovery with conservative management, while 20% of acute ankle sprains develop mechanical or functional instability resulting in chronic ankle instability, which may lead to early degenerative changes in the ankle due to unbalanced loading on the medial side of the ankle. Indications for lateral ligamentous reconstruction include persistent symptomatic mechanical instability and failed functional rehabilitation. The goal of diagnostic and therapeutic approach is to stop the progression of laxity and to protect the ankle against degenerative arthritis, which is the main risk in these chronic conditions.
Purpose of this study is to develop an algorithm for surgical treatment of ankle instability basing on our personal experience and literature review.
The major underlying pathology of CAI is usually tearing of the anterior talofibular ligament (ATFL), with or without the calcaneofibular ligament (CFL), which may require surgical intervention.
Numerous surgical procedures have been described for the treatment of chronic lateral ankle instability. Today, surgical treatment of lateral ankle instability can be divided into anatomic reconstruction, nonanatomic reconstruction and anatomic repair.
Anatomic reconstruction of ankle stability, based on the Broström procedure, is usually the first choice of treatment for persistent ankle instability. Numerous studies have shown good-to-excellent results with anatomic repairs, with over 85% of patients achieving good outcomes. The longevity of anatomic repair is well established.
Numerous stabilization techniques have been described including either primary repair or secondary repair using tenodesis techniques. Multiple techniques have been described for tenodesis repair, both anatomic and nonanatomic, as well as single- (ATF) versus double- (ATF and CF) ligament repairs. Nonanatomic, single-ligament and double-ligament repairs have been described most commonly using the peroneus brevis (PB) tendon; however, sacrifice of the primary everter of the foot and ankle and nonanatomic configurations have been shown to have suboptimal effects on the ankle joint, including limitation of subtalar motion and reduction of eversion strength.
However, a review of the literature showed that 13% to 35% of patients still had symptoms even after successful ligament reconstruction and that intra-articular lesions were considered to be the cause of these persistent symptoms. Anatomic repair of the insufficient ligaments is appealing because the insertion points of each ligament are restored. In turn, the normal kinematics of the affected joints, the ankle and subtalar, are maintained. This may be important, as the ankle and hindfoot complex is stressed through the entire range of motion during vigorous physical activity. Furthermore, the restoration of both of the affected ligaments in anatomic fashion eliminates the possibility of subtle or overt restriction of supinatory motion of the ankle that occurs in nonanatomic configurations. These changes include inhibition of hindfoot range of motion, loss of long-term stability, and medial degenerative changes. In effect, less satisfactory results are realized.
Anatomic repair of the anterior talofibular and calcaneofibular ligaments is recommended when the quality of the ruptured ligaments permits. Nonanatomic tenodesis reconstructions have poor long-term results, sacrifice peroneal tendons, and disrupt normal ankle and hindfoot biomechanics. Anatomic reconstruction with autograft or allograft should be performed when ligaments are attenuated. The role of arthroscopic reconstruction is evolving. Ankle arthroscopy should be performed at the time of repair or reconstruction and should address any other intra-articular causes of pain.

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Scaffolds in tendon and ligament repair: a critical review

Gigante, A. Busilacchi
Clinical Orthopaedics - Dept. of Molecular Pathology and Innovative Therapies, School of Medicine, Marche Polytechnic University, Ancona, Italy

From the silver wire introduced in 1914 by Corner to our days the repair of big defects in ligaments and tendons was faced in different ways: autologous or homologous grafts, synthetic wires and biological scaffolds were widely used. The surgeon has now the possibility to implant new devices which overcome the problem of the donor site morbility and complications encountered with the use of autograft tissue. To find the most suitable material for the scaffold, artificial polymers, biodegradable films and biomaterials derived from animals or human were studied in these last 20 years.
Although biological scaffolds, also named bioscaffolds, are the most recent and with few clinical results, they raised a huge interest in the scientifical community. Bioscaffolds are a protein-based extracellular matrices (ECM) of human or animal derivation. They have a well structured tridimensional surface, microstructure and natural porosity in order to quickly interact with host tissue and induce new tissue formation faster than synthetic scaffolds thrugh the population of the native cells. The ideal scaffold should induce host-tissue ingrowth and tendon regeneration during the process of degradation, which varies dramatically among the commercially available scaffolds.
We performed a search of PubMed, Medline, Cochrane, and Embase inserting commercial names of each scaffold and the following keywords: 'tendon repair', 'rotator cuff', 'supraspinatus tendon', 'scaffold', 'biomaterials', 'extracellular', 'matrix', 'tendon substitute', and 'artificial ligament' 'artificial tendon'. The literature among 1975 and 2009 was consulted as well as their bibliographies used for further references in the assigned subject.
The research and development phase on this products passes throughout a long period pre-clinical study. First step of the research is the in vitro study where the cell viability on the scaffold is assessed. Then, the study on animal models is performed in order to confirm the cell viability, the integration of the scaffold as well as to observe adverse events. Finally biomechanical data are collected, carrying out the tensile tests. Only when pre-clinical studies are positively concluded clinical trials may take place.
By the review of the literature bioscaffolds show advantages like the capability to decrease the in vivo mechanical forces on the repaired tendon during post-operative healing, to prevent repair-gap formation or failure, to facilitate the native cell ingrowth. Limitations of biological scaffolds are low mechanical properties (cause of potential failure of the implant), unspecific degradation rate, variation in biocompatibility depending on the source of raw material, which can cause inflammatory response and even implant rejection. Furthermore the mechanical property of the new tissue grown in the scaffold has are not the same of the native tissue, even after years by the surgery.
Synthetic scaffolds of the last generation seems to show improved cell viability properties, but having a poorer biocompatibility because they are not able to integrate into native tissue. On the other hand they are completely indu-

strial chemistry products, fact which permits the control of chemical and physical properties leading to better mechanical properties. High incidences of postoperative infection and chronic immune response have been reported with the use of such materials.
As regards bioscaffolds aseptic reactions were reported in 16-22% of cases in preclinical models, always with negative aspirates and cultures, destroyed xenografts and histopathological evidence of inflamed granulation tissue with abundant neutrophils, but no foreign body reaction, as documented by the absence of organisms, crystals or giant cells in biopsies. The prevalence of postoperative complications in patients encountered with their use varies within the different studies.
The capability of inducing host-tissue ingrowth by bioscaffold is superior as compared with synthetic ones, even though this process appears not deeply investigated. Apparently bioscaffolds enhance the healing phase, replacing an organized new tissue over time.
In conclusion, the reviewed studies support the idea that these biomaterials can provide an alternative for tendon repair but the available data are lacking to draw absolute conclusion on the use of biomaterials for tendon augmentation. More correctly we should consider their clinical use as augmentation devices and not as tendons/ligaments substitutes, preferring to autograft only there is no availability of donor sites or possible complication by its harvesting.

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Artroscopic laterjet for shoulder instability. Difficulty of the learning curve and true indications

A. Grasso, M. Salvatore, C. Latte
Casa di cura Villa Valeria, Rome, Italy

Anterior shoulder instability represents the 95% of shoulder instabilities. The incidence of antero-inferior instability is highest in patients younger than age 30 years and its etiology is nearly always traumatic. The golden standard treatment for this instability is the arthroscopic Bankart procedure even if this technique may result in unsatisfactory outcomes when the instability is associated to a humeral or glenoid bone loss. In this cases the best choice is a bony block procedure like the Latarjet technique that showed a high rate of success. Some authors in 2005 stated that the Latarjet procedure was impossible to perform arthroscopically but in 2007 the arthroscopic Latarjet procedure was described by Lafosse and colleagues.
From March 2011 to June 2011 we performed 12 arthroscopic Latarjet procedures. All patients were males, the mean age was 33,6 (min 27-max 46), 3 were left and 9 were right, 10 dominant arm and 2 controlateral one. All had a history of recurrent shoulder dislocations, clinical findings of antero-inferior shoulder instability and evaluated with TC PICO scans revealed a bone loss pattern either of the glenoid or humeral. All procedures were performed in beach-chair position. All patients underwent a double anaestesia both general and loco-regional. All patient were evaluated before the surgery and a 3 months follow up with subjective scoring tests (Simple Shoulder Test, Italian version of SF-12, Italian version of Quick DASH) and with objective scoring test (Clinical findings, Rowe score, Constant score). About the surgical technique the first three surgery was performed as Lafosse originally described, the other ones was performed cutting out the axillary portal. The surgery time was taken to evaluate how much time the arthroscopic procedure pay to open Latarjet procedure.
Even if our cases are few first results are encouraging and agreeding with the literature 3 months follow-up evaluation revealed an increasing of values of both subjective scores and objective scores. We never reported complication

like neurovascular injury or infection, in one procedure a coracoids bone block breaking occurred and the arthroscopic procedure turned in a open procedure. In another case a anaesthesiological complication occurred but luckily resolved in a delayed awakening of 4 hours. The surgery time showed a progressive reduction of the surgical time with a mean time of 64,4 minutes (min. 43m-max. 109m).
The Latarjet procedure is a reliable method of treatment for anterior instability, with good results reported in many studies. The functional results and outcomes after a Latarjet procedure seem to be similar to those seen after a Bankart procedure, with many comparative studies reporting no difference in outcome score or recurrence. The arthroscopic procedure let a skilled surgeon to improve the visualization for positioning the coracoids, via various portals, whereas the open procedure can often be complicated by a limited exposure, especially in young athletes with significant musculature. We cut the axillary portal described originally by Lafosse because we believe that a good visualization of the shoulder is achievable without performing this portal. We prefer the double anesthesia, both general and locoregional so that controlling pain during surgery and after is possible to maintain the low blood pressure values fundamental to perform this surgery. The evaluation of surgery time revealed that even if arthroscopic Latarjet procedure is a complex procedure that requires a degree of experience and expertise it is a reproducible technique with surgical times comparables with those of open technique.

When, where, how tendons research started

Ernesto Ippolito, Salvatore Bisicchia
Department of Orthopaedic Surgery, University of Rome "Tor Vergata"

In 1961, the main topic of the annual meeting of the Italian Society of Orthopaedic Surgery was "Tendon's traumatic lesions". The main speaker was Prof. Mario Boni (1) and one of the co-authors was my previous head Prof. Lamberto Perugia who was very much interested in tendon pathology. Under his guide, in 1970 a research team composed by myself, Dr. Franco Postacchini, Dr. Giancarlo Puddu and Dr. Cesare De Martino started to work on tendon structure and pathology at the University of Rome "La Sapienza". Following the studies of Arner and Lindholm (2) - who were among the first to describe pathologic lesions underlying subcutaneous rupture of tendon - we carried out histopathological studies in every case of tendon's pathology undergoing surgery. We also started to study the normal structure and biochemistry of tendon in animals as well as tendon regeneration after traumatic lesions experimentally induced.
Tendon tissue undergoes marked morphological and biochemical changes with age (3-9). The extracellular matrix increases in volume, causing a relative decrease of the number of cells. The tenoblats become longer and more slender and their cytoplasmatic processes increase in number, forming a dense network. Collagen fibers increase in diameter and vary more in tickiness. Actin and myosin are present in tendon cells and their content does not change with age. Aerobic glycolys provides the main energy during the first 3 months of life in rabbit Achilles tendon, whereas from this age on anaerobic glycolysis supports tenocytes metabolism.
The regenerated tissue which fills the gap between the stumps of sectioned and unsutured rabbit calcaneal tendon during the first days after tenotomy is made by spindle-shaped cells arranged along the major tendon axis. Bundles of collagen fibrils are arranged parallel to the cells. In the subsequent stages, the regenerating tissue becomes more compact, however even at 30 weeks after tenotomy it does not show the typical structure of the normal adult tendon. We speculated that the lack of maturation might be due to the reduced mechanical stress.
According to our histopathological studies, a classification of tendon diseases was published (10-15) in which the main forms were: a) Pure peritendinitis or tenosynovitis, characterized by chronic inflammation of the peritendinous sheaths; b) Pure tendinosis, in which the changes are confined to degenerative phenomena in the tendon Hyaline, fatty and myxoid degeneration are mostly represented, but areas of bony metaplasia and calcified cartilage may be present as well; c) Peritendinitis or tenosynovitis associated with tendinosis. Pure tendinosis is symptomless and is revealed only by subcutaneous rupture of the tendon. Based on these pathologic findings, we affirmed that tenolysis alone is indicated only in pure peritendinitis or tenosynovitis, whilst in peritendinitis or tenosynovitis associated with tendinosis, scarification of the tendon must be associated with tenolysis. The object of scarification is to promote substitution of the degenerated tissue with newly formed tendon tissue. In the early 1980's the team ceased its research activity on tendons. During the last 30 years tendon's research made enormous progress in many laboratories scattered throughout the world. In a recent paper (16), pathophysiology of some degenerative forms has been discovered. Tendons contain tendon stem cells that have the multi-potential to differentiate into tenocytes and cells of non-tenocyte lineages, including adipocytes and osteocytes. Cyclic mechanical stretching of tendons experimentally induced in animals produces tendinopathy similar to overload tendinopathies observed in athletes with increased release of prostaglandin E2 (PGE2) by tenocytes. PGE2 in turn stimulates differentiation of tendon stem cells into adipocytes and osteocytes. Our old seeds keep generating new striking results in the field of tendon research!

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Tendinopathy not a localized problem

Umile Giuseppe Longo[1], Nicola Maffulli[2], Vincenzo Denaro[1]
[1]Department of Orthopaedic and Trauma Surgery, Campus Biomedico University, Rome, Italy
[2]Centre for Sports and Exercise Medicine, Barts and The London School of Medicine and Dentistry, Mile End Hospital, England

The aim of this study is to analyze the histopathological features of surgical specimens of supraspinatus tendon from the macroscopically intact supraspinatus tendon of patients with rotator cuff tears. Tendon samples were harvested from 88 individuals (49 men, 39 women; mean age: 58.2 years) who underwent arthroscopic repair of a rotator cuff tear, and from 5 male patients who died of cardiovascular events (mean age: 69.6 years). A full thickness supraspinatus tendon biopsy was harvested *en bloc* within the arthroscopically intact middle portion of the tendon. Using Haematoxylin and Eosin staining, slides were assessed twice by the same examiner using a semiquantitative grading scale assessing fiber structure and arrangement, rounding of the nuclei, regional variations in cellularity, increased vascularity, decreased collagen stainability and hyalinization. Intra-observer reliability of the subscore readings was calculated.
The mean pathologic sum-score of ruptured tendons was significantly greater than the mean pathologic score of control tendons. Within each specific category of tendon abnormalities, the control and ruptured tendons were significantly different (chisquare test); all variables were significantly different. There was good agreement between the two readings.
Non ruptured supraspinatus tendons, even at an advanced age, and ruptured supraspinatus tendons are clearly part of two distinct populations.
During cuff repair, it is not necessary to excessively freshen the torn tendon to bleeding tissue: the macroscopically intact supraspinatus tendon is degenerated as well, and the failed healing response is not limited to the ends of the torn tendon.

Achilles tendinopathy. Recent advances in surgical procedures

Nicola Maffulli
Centre for Sports and Exercise Medicine, Barts and The London School of Medicine and Dentistry, Mile End Hospital, England

Tendon injuries can be acute or chronic and caused by intrinsic or extrinsic factors, either alone or in combination. Tendinopathy is essentially a failed healing response with haphazard proliferation of tenocytes, abnormalities in tenocytes with disruption of collagen fibers, and subsequent increase in non-collagenous matrix. The scientific evidence base for managing tendinopathies is limited. Minimally invasive techniques in orthopaedic surgery minimize the problems posed by open surgery, reducing complications and postsurgical recovery. Minimally invasive surgery represents new options for the management of tendinopathy. Open surgery aims to excise fibrotic adhesions, remove areas of failed healing, and make multiple longitudinal incisions in the tendon to detect intratendinous lesions and to restore vascularity and possibly stimulate the remaining viable cells to initiate cell matrix response and healing. New surgical techniques aim to disrupt the abnormal neoinnervation to interfere with the pain sensation caused by tendinopathy. These procedures are intrinsically different from the classical ones in present use as they do not attempt to directly address the pathological lesion, but act only to denervate them. They include endoscopy, electrocoagulation, and minimally invasive stripping. Percutaneous longitudinal tenotomy is simple, requires only local anaesthesia, and can be performed without a tourniquet. If post-operative mobilisation is carried out early, preventing the formation of adhesions, this will allow the return to high levels of activity in the majority.

Single or double bundle in ACL reconstruction. What is the true?

Nicola Maffulli
Centre for Sports and Exercise Medicine, Barts and The London School of Medicine and Dentistry, Mile End Hospital, England

There is a scientifically unsubstantiated trend for using double-bundle (DB) techniques for reconstruction of the anterior cruciate ligament (ACL). The functional outcome of DB techniques is equivalent to single-bundle (SB) techniques. Sample size calculation should be included in the design of a randomised controlled trial to ascertain the superiority of one technique over the other. Aims of ACL reconstruction are prevention of osteoarthritis and episodes of giving way. Given a significance level of 1% and a power of 90%, we would require a sample size of at least 1400 patients to detect a 2% difference in rate of osteoarthritis between the two groups at 10 years of follow up. Given the lack of scientific evidence and despite the enthusiasm of surgeons for DB reconstruction techniques, SB ACL reconstruction remain the standard for managing ACL-deficient knee, and it should be not abandoned until DB ACL reconstruction technique is proven superior.

Rehabilitative treatment of patients affected by rheumatic enthesitis

Stefano Masiero, Antonio Frizziero, Claudio Ferraro
Department of Rehabilitation Medicine, University of Padua, Italy

Spondyloarthritis is the name of a family of rheumatic diseases that are characterized by arthritis of the spine and peripheral joints, inflammation in the area where ligaments and tendons attach to bones (enthuses), and inflammation of the skin, intestines and eyes (1). With regard to Ankylosing Spondylitis (AS) that is a prototype of group spondyloarthritis, Assessment in AS (ASAS)/EULAR guidelines recommend to combine pharmacological and non-pharmacological therapy in the management of patients with AS (2). The treatment will depend on the severity and predominant manifestations of the disease. The predominant manifestations that must be considered are the pain, the postural modification, the fatigue, the respiratory restriction, and no rarely the depression. These clinical manifestation determine

an activity limitations on self care limitation, ambulation and activities of daily living with consequently negative impact on employment and social and leisure activities. Among the pharmacological treatments, TNF inhibitor therapy with four currently approved agents - infliximab, etanercept, adalimumab and more recently golimumab - has clearly been shown to improve signs and symptoms, function, spinal mobility and enthesitis for improving functional outcomes in the short term but also in the long term by up to 5 years.

The ASAS/EULAR working group (2) suggested that non-pharmacological therapy, which is recommended for all phases of the disease, could include: a) physiotherapy (respiratory exercises and exercises to mobilize the vertebrae and limbs, balancing and proprioceptive exercises, postural exercises and spinal and limb muscle stretching and strengthening, endurance training exercises, postural exercises and spinal and limb muscle stretching and strengthening, proprioceptive exercises), b) physical therapy, c) orthosis and occupational therapy, d) educational-behavioural programme to patient and family with psychological support. Therapies focused on individualized functional goals identified on admission to rehabilitation by the interdisciplinary team.

Exercise play an important role in management, particularly when performed in a supervised outpatient group or intensively in inpatients who show short-term improvement (3-5). In fact, on the basis of previous results, various other studies show that inpatient intensive rehabilitation is effective in inducing short term improvement in spinal mobility (6), but doubts remain about sustained improvement after long periods (7-9). In the era of biologics, we would consider still a combined approach between biological agents and rehabilitation, but at present, a few papers have investigated this field (10-12). However, the firsts study suggest that combining rehabilitation and TNF inhibitor treatment can provide promising results in the management of patients with AS. A possible explanation for the good results obtained was that the tumor necrosis factor-α (TNF) antagonist, acting on inflammation and reducing fatigue, improved the effectiveness of a rehabilitation program, resulting in better functional status, better quality of life, and better perception of benefits obtained from the rehabilitation (12, 13).

The goals of rehabilitation include: a) pain relief, decrease of consumption of NSAIDs and physician visits, b) reduction stiffness and fatigue, c) increase of spinal mobility and chest expansion, d) to maintain good posture, e) to maintain/improve physical function, physical fitness, and well-being, f) maximize functional independence and to maintain the social role in community and in families. The main factors affecting rehabilitation outcomes could be: a) motivation level, knowledge of the importance of exercise, b) level of emotional and social support, c) coping and adaptability, d) medical comorbidities, e) fatigue and pain.

In conclusion, we believe that the rehabilitative treatment of patients affected by rheumatic enthesitis can help to maintain function and reduce the disability in all the phase of disease and the phase of disease determine the modality of treatment.

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Role of oxidative stress and changes in growth factors in sarcopenia

Antonio Musarò
Institute Pasteur Cenci-Bolognetti; DAHFMO-Unit of Histology and Medical Embryology, IIM; Sapienza University of Rome, Italy

Muscle senescence is a complex mechanism that is usually associated with a decrease in mass, strength and velocity of contraction. This state, known as sarcopenia, is a multifactorial process caused by a reduction or complete loss in the motor units, a decrease in the synthesis of the myofibrillar protein components with the consequent atrophy and accumulation of connective and adipose tissue.
It is generally accepted that the primary cause of functional impairment in senescent muscle is a cumulative failure to repair damage, resulting from sustained muscular activity, related to an overall decrease in anabolic processes (Carosio et al., 2011). It has been suggested that the decline in the regenerative potential of senescent muscle is mainly due to a decline in satellite cell number. However, other evidences suggested alternative explanations. It has been reported that the dramatic age-related decline in myoblast generation in response to injury is due to an impairment of activation rather than a decline in number of satellite cells, suggesting a critical role of the tissue niche in the activation of satellite cells and therefore the entire regenerative program (Conboy et al., 2005; Carosio et al., 2011).
There is a growing body of evidences suggesting a correlation between high levels of inflammatory cytokines, low levels of IGF1, high levels of oxidative stress, decreased mitochondrial function and muscle weakness (Capri et al., 2006). The related cellular and molecular mechanisms are complex and most probably result from the alteration of a variety of interrelated cellular and molecular mechanisms such as ROS production, mitochondrial function, proteosome activity among others, all of which can have an impact on survival, repair and maintenance of muscle cells and their microenvironment. We are characterizing the molecular mechanisms that regulate the phenotypic changes leading to the pathological pattern of muscle aging. Interestingly, the decrease in IGF-1 expression, observed during aging, is associated with an increase in oxidative stress and cytokine expression. Is there any correlation between IGF-1 and inflammatory response and oxidative stress? It is known that elevated inflammatory signals are associated with reduction in anabolic growth factor signals, and this unbalance may have the most relevance for the development and progression of sarcopenia and age-related physical decline. We have evidences that local expression of IGF-1 accelerates muscle regeneration by rapidly modulating inflammatory cytokines and chemokines (Pelosi et al., 2007; Scicchitano et al., 2009). It is known that IL-6 levels increase during aging, suggesting a causal role of IL-6 in the reduction of physical performance in elderly. Our preliminary evidences support this hypothesis. Interestingly, the severity in the reduction of muscle mass seems related to the different levels of IL-6 in skeletal muscles.
Another factor that potentially play a critical role in the pathogenesis of sarcopenia is the oxidative stress. It has been reported that IGF-1 inhibits oxidative stress in vivo and in cultured endothelial cells. Thus a reduction in IGF-1 might be associated with an increase in the oxidative stress and therefore to the progression of the pathological phenotype associated with aging. However it is not clear whether oxidative stress is a trigger o a target of muscle atrophy. To verify this we are using a transgenic mouse in which a mutated form of the anti-oxidant gene SOD1 was selectively expressed in skeletal muscle. We have been demonstrated that local expression of mutant SOD1 causes muscle atrophy associated with the reduction in muscle strength, reduction in protein synthesis and increase in protein degradation (Dobrowolny et al., 2008; Aucello et al., 2009; Dobrowolny et al., 2011).
These preliminary studies provide exciting avenues for future discovery, however true innovation in this field will undoubtedly derive from the integration of our insights with other key advances in regenerative research, to form a cohesive and coherent strategy that addresses the short, medium and long-term aspects of the therapeutic process (Scicchitano et al., 2009).

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Clinical approaches for muscle injuries

Gianni Nanni
Centro Studi Isokinetic, Bologna

Muscle injuries are common in sports and in some disciplines, such as soccer, make up over 40% of all injuries.
Depending on the lesion mechanism they are divided into direct and indirect trauma muscle lesions and classified into 1st, 2nd, and 3rd degree depending on the severity of the injury (6, 7).
In this regard it is good to remember that with the same degree lesion, the healing will be faster with those that will cause intermuscular hematoma, which usually shows a bruising downstream of the lesion, compared to the lesions characterized by an intramuscular hematoma (7).
Our case study was collected from 1987 to 2008 and consists of 1343 cases of muscle injuries caused by indirect trauma and 78 caused by direct trauma.
In all these cases a clinical assessment and at least one ultrasound examination were made.
The clinical evaluation (history and physical examination) was very important in making a diagnosis of muscle injury, a precise prognosis and directing the rehabilitation program and functional outcome, particularly in the field's phase of rehabilitation (3).
It's not always possible to have a Nuclear Magnetic Resonance to evaluate muscle damage.
In this case the clinical examination, comforted by an ultrasound evaluation, is the only resource available to the doctor.
With muscle injuries, especially those of 2nd and 3rd degree, the athlete reports sudden pain during a precise technical gesture, with instant functional impotence (3, 5, 7).
It is important to understand how the accident occurred and what technical act caused the injury because this will affect the rehabilitation phases, especially the one in the field, before returning to play sport without limitations.
The location of the lesion, especially for certain muscles such as hamstrings, rectus femoris and adductors, determines a different prognosis depending on the lesion's proximity to the proximal insertion (1, 3).
The more proximal the injury the longer the healing time (1).
In these cases occurrence of complications such as scarring, is more frequent, which can prolong the recovery time and may promote the occurrence of re-injuries (3).
During the objective examination, especially for 1st grade lesions, it's very useful to perform, under pain threshold, contraction against manual resistance tests, at different degrees of articulation, of the joint proximal and distal to the injured muscle (hip and knee for example for what it regards hamstring injuries).
This is done to better identify the injured muscle and the specific area of lesion (3).
The extensibility test, compared with the controlateral limb, should always be performed in doubtful cases or during the rehabilitation program of muscle injuries to decide when it is appropriate to start with the rehabilitation in the field (2).
For each muscle we can perform an extensibility test that needs to be carefully monitored during the whole rehabilitation program.
The onset and persistence of pain, even if it doesn't impede the carrying out of the rehabilitation sessions with the exercises provided, if accompanied by a positive extensibility test, can make suspect the onset of a complication.
If the pain is acute, sudden, when performing an exercise or technical act and is accompanied by a new positive test of extensibility (previously negative) it's very likely that we are facing a re-injury of the lesion.
During the examination, we must also assess, if there are predisposing factors to muscular lesions, clinically detectable as lack of extensibility of the antagonistic muscles, joint laxity, poor core stability, muscle wasting, lack of articulation (4, 5, 8, 9).

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Matching structural design to function of human skeletal muscle

Marco Narici
Manchester Metropolitan University Institute for Biomedical Research into Human Movement

The close relation between muscle structure and function has been first formalised by the Danish anatomist Nicolaus Stenosis (Steno, 17th C). Steno made the original observation that, upon contraction, muscle fibres rotate about their origin and increase in angle: *"dum contrabitur musculus, anguli eius acuti siunt ampliores".* He also described the iso-volumetricity of muscle contraction. Much progress has been made since Steno's seminal work and it is now fully recognised that muscle architecture is a main determinant of muscle's functional performance. Out of the ~650 muscles of the human body, some are parallel-fibred, but the majority have a pennate arrangement, as this affords greater packing of contractile tissue along the tendon aponeuroses. Pennate muscles typically have shorter fibres than parallel-fibred ones and therefore have a lower number of sarcomeres in-series. However, for the same volume, they have a greater number of sarcomeres in-parallel and thus a larger physiological cross-sectional area. These distinct anatomical characteristics are reflected by different functional properties, for pennate muscles are stronger and slower contracting than parallel-fibred ones and thus display different Force-Velocity relationships. Also, because of the shorter fibres, pennate muscles have smaller functional ranges and narrower Length-Tension (L-T) relationships. However, *in vivo*, the resulting Angle-Torque relation depends on the muscle L-T as well as on the Angle -Moment arm length (*d*) relations.
Moreover, the change in fascicle length upon joint rotation depends on *d*. Therefore, two muscles with identical fascicle lengths (Lf) but with different *d* will shorten by a different degree upon joint rotation. For the same Lf change, the greater the *d* and the smaller the joint rotation. However, the change in Lf also depends on the ratio between tendon length and fascicle length. It follows that the rate of shortening of a muscle (V) is the product of joint angular velocity (A_V) and *d* and for both short and long-fibred muscles fascicles should shorten at their optimum velocity (Vopt) for maximum power delivery. Longer fibres will have a greater number of sarcomeres (*n*) in series than shorter fibres, thus their Vopt will be higher, but if each sarcomere shortens by the same extent, Vopt/*n* will be constant. From this consideration, Alexander RMcN (Nether J Zool, 50, 2000) predicted that through evolution, *d* and *n* have been adjusted as to enable muscles deliver maximum power at their Vopt, i.e.: $A_V \cdot d/n = (V/n)$. Muscles *in vivo* have been shown to shorten at their Vopt in order to deliver maximum power at different movement speeds (L. Rome LC et al. Nature, 335, 1988). This requirement is met thanks to the recruitment of different populations of muscle fibres each with distinct MHC composition and Vopt (Bottinelli et al. Physiol, 495, 1996).

Sarcopenia – Characteristics, Mechanisms, and Functional Significance

Marco Narici
Manchester Metropolitan University
Institute for Biomedical Research into Human Movement

Sarcopenia reflects a progressive withdrawal of anabolism and an increased catabolism, along with a reduced muscle regeneration capacity. Muscle force and power decline more than muscle size: older muscle is intrinsically weak, due to muscular, tendinous and neural alterations. Neuropathic, hormonal, immunological, nutritional and physical activity factors contribute to sarcopenia and sarcopenic obesity among the elderly corroborates to the loss of muscle mass increasing the risk of metabolic syndrome development. Selective fast fibre atrophy, loss of motor units and an increase in hybrid fibres are typical findings of ageing. Satellite cell number and activation thereof decrease with old age, resulting in a reduction in muscle regenerative capacity. Basal protein synthesis and breakdown show little changes in old age. Activation of the ubiquitin proteasome system seems confined to inflammation -induced atrophy. Instead, blunting of the anabolic response to feeding and exercise, particularly in older women, and of the anti-proteolytic effect of insulin is observed. Further understanding of the mechanisms of sarcopenia also requires disentangling of the effects of ageing alone from those of disuse and disease. Regular resistive exercise is a most effective intervention for slowing down the age-associated decrease in muscle mass. Some evidence exists that it may also afford protection against the loss of motor units, as suggested by observations on master athletes. Also, muscle fibre myonuclei acquired during resistive training are preserved for several weeks of subsequent detraining. This 'muscle memory' seems particularly relevant for the ability of muscle growth and regeneration in old age. Among the various pharmacological treatments for preventing sarcopenia, the use of selective androgen receptor molecules and anti-myostatin antibodies seem particularly worthy of attention.

Peroneal Dislocation. SPR reconstruction with absorbable anchors

Francesco Oliva
Department of Orthopaedics and Traumatology, Faculty of Medicine and Surgery, University of Rome 'Tor Vergata', Rome, Italy

Recurrent peroneal tendon subluxation is an uncommon sports-related injury. The retrofibular groove is formed not by the concavity of the fibula itself, but by a relatively pronounced ridge of collagenous soft tissue blended with the periosteum that extends along the posterolateral lip of the distal fibula. The shape of the groove is primarily determined by this thick fibrocartilagenous periosteal cushion, and not by the bone itself (1). The superior peroneal retinaculum is extremely variable in width, thickness and insertional patterns. Peroneal tendon subluxation is commonly associated with longitudinal splits in the peroneus brevis tendon and lateral ankle instability. Disruption of the lateral collateral ankle ligaments places considerable strain on the superior peroneal retinaculum. This explains why the two conditions commonly coexist (2). In recurrent subluxation, patients usually give a history of previous ankle injury, which may have been misdiagnosed as a sprain. An unstable ankle that gives way or is associated with a popping or snapping sensation is another common complaint (3). The peroneal tendons may actually be seen subluxing anteriorly on the distal fibula during ambulation. The role of imaging has been debated, and the diagnosis and management plan are based on clinical evidence. Conservative management may be attempted in acute dislocations, and can be successful in up to 50% of patients, although there is a trend for operative management in athletes (4). Recurrent dislocations should be managed surgically. Five basic categories of repair have been described: (i) anatomical reattachment of the retinaculum; (ii) bone-block procedures; (iii) reinforcement of the superior peroneal retinaculum with local tissue transfers; (iv) rerouting the tendons behind the calcaneofibular ligament; and (v) groove deepening procedures. However, it is impossible to determine from the relatively small series which procedure is superior. If an anatomical approach to treating the pathology is utilised, reattachment of the superior retinaculum seems a most appropriate technique. We have previously described our own anatomical reconstruction procedure of the superior peroneal retinaculum using anchors (5). Randomised controlled trials may be the way forward in determining the best surgical management method. However, the relative rarity of the condition and the large number of techniques described make such study difficult (6).

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Slap lesions: to treat or not to treat?

L. Osti
Unit of Arthroscopy and Sports Medicine
Hesperia Hospital Modena, Italy

Slap lesions has become a very controversial topic in shoulder surgery in the recent past. Snyder first introduced the Slap definition of a lesion of the superior part of the labrum in the 90's (Superior Labrum Anterior Posterior) defining 4 types of Slap lesions. A growing interest on this pathology through the years produced a more complete classification of 10 Slap types with different pattern of lesions for the labrum itself and for the proximal biceps tendon. History can be more helpful for the rarest traumatic lesions, however this pathology can be suspected in patients without trauma history involved in overhead sports and activities. Clinical examination can relay on specific tests for SLAP tear such as O'brien Crunck and Speed tests with a variable lack of specificity reported and different methodologies applied in the peer rewieved studies. Possible associated pathologies such as rotator cuff tear and instability should be ruled out and evaluated as contributors of the symptoms referred to the Slap lesion. Imaging supported the role of MRI as the golden standard for both sensibility and specificity with enanched accuracy obtained trough arthrogram exams and ABER (abduction external rotation) position. Conservative treatment throuh capsular streching and muscle balancement play an important role as a first line of treatment with a possible reduction of related symptoms and quality of life emprovement. Arthroscopy is the final step for both diagnosis and treatment. Surgical treatment should be tailored according to the Slap type ranging from simple debridment to Slap repair and byceps tenotomy. Age and type of Slap tear can influence the decision making between Slap repair and biceps tenotomy, with or without tenodesis. Slap repair can be carried out using both metal or bioadsorbable anchors and even a single anchor can stabilize a Slap tear. Single portal and percutaneous repair has been introduced as reliable approaches to reduce surgical morbidity. Associated pathologies such as rotator cuff tears, spynoglenoid cysts and labral tears should be accurately evaluated and treated simoultaneously. Several reports outlined an increased trend for stiffness related to the SLAP tear repair without a well definied role of surgical techique itself or post-op regimen (immobilization and rehabiliation). Decision making for surgical treatment should be carefully evaluated in each case with more straightford selection for the traumatic lesion such as the more common type II in younger patients and special care should be taken for the overhead athlete.

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Massive rotator cuff tears. Strategies of treatment

Giuseppe Porcellini, Fabrizio Campi, Paolo Paladini
Unità Operativa di Chirurgia Ortopedica della Spalla, Ospedale "D. Cervesi", Cattolica, Rimini, Italy

Rotator cuff tears are a common source of pain and disability in the shoulder even in middle age patients. A rotator cuff tear is present in 20.7% of the general population and the prevalence increases with age (4, 24). The rate of subjects with symptoms related to the shoulders probably affected by a cuff lesion is 36% in general population, while 16.9% of the subjects without symptoms also had rotator cuff tears. Rotator cuff tears in the general population are most commonly in elderly patients, males, affecting the dominant arm, engaged in heavy labor, having a history of trauma (24). When conservative treatment fails, operative treatment is an option to improve the patient's condition (13, 23). Operative repair of small and medium-sized RCT consistently yields good and satisfactory outcome in a high percentage of patients (6, 8), even in case of structural failure of rotator cuff repairs (14). In contrast, surgical treatment of large or massive RCT can be technically difficult and it's results are more inhomogeneous. Size of tendon tear and muscles fatty infiltration are strictly related with clinical outcomes (1, 11, 19). In particular, arthroscopic repair of large and massive rotator cuff tears can lead to excellent pain relief and improvement in the ability to perform activities of daily living at short term follow up, despite the high rate of recurrent defects; however, at a minimum follow-up of two years, the clinical results seems to deteriorate (7, 9). Although most rotator cuff tears and the majority of massive rotator cuff tears can be completely repaired to bone (5), a significant proportion of these cannot be sutured by these traditional techniques for the size of the tear and the retraction of the tendon (1). Numerous operative techniques have been described for the treatment of massive rotator cuff tears with severe retraction where anatomical repair is impossible such as: arthroscopic debridement and/or biceps tenotomy, tendon transfers and grafting and partial repair of the remaining rotator cuff tendons (6). Burkhart (3) first introduced the concept of functional repair of the cuff to restore force couple of the humeral head and to increase the Acromion-Humeral Distance (AHD). In these arthroscopic procedures the complete closure of the defect was not considered to be essential to restore the normal cuff biomechanics (3,18). The technique provides the peripheral repair of the margins of the tear to restore the force couples, anterior and posterior, and the "suspension bridge" system of force transmission in the shoulder. Outcomes are obviously lower than those related to complete rotator cuff repair (2, 3, 20) but remain stable for AHD even at medium term follow up (25). Previous authors have introduced the radiographic evaluation of the acromion-humeral distance as a standard technique in orthopaedic routine. A decreased AHD is the most reliable radiographic finding for rotator cuff tears (10, 12, 16, 21); an AHI of less than 6 mm has been considered proof of a tear of the rotator cuff tendons (17, 22) and the thinning of the AHD is strictly related with the size of the cuff tear (15). The purpose of this study is to evaluate clinical results and radiological changes of AHD in patients treated with arthroscopic partial suture of irreparable tears of supraspinatus tendon at long term of follow up (5 years).
In this case series study, 153 consecutive patients affected for irreparable cuff tears were arthroscopically treated with a partial suture of the cuff from January 2000 to March 2004. We considered only patients affected by posterior-superior cuff lesion with a Grade I or II of fatty degeneration for infraspinatus and a Grade III or IV of fatty degeneration for supraspinatus. Constant score increased from a mean of 44 points (min 18, Max 69; St. Dev: 14,1) to a mean of 73 points (min 30. Max 86, St. Dev: 11,9). **SST score** increased from a mean of 4.6 (min 2, max 9: St. Dev: 2,3) to a mean of 9 (min 3, max 12; St. Dev: 1,8). **AHD** increased from 6.1 mm (min 4.3 mm; max 9.7 mm; St. Dev. 1.6 mm) to 9.1 mm (min: 2 mm, max 14,8 mm; st. Dev: 2.2). The mean increase is of 3.0 mm ($p<0.05$).
This study evaluated clinical results of arthroscopic partial suture of the cuff at long term of follow (5 years) up and related clinical results to radiological changes of Acromion-Humeral Distance (AHD) in patients with irreparable supraspinatus tear. The present study indicates that, in cases of massive RCT, long-term results of partial repair of the posterior cuff with the covering of infraspinatus footprint seems to provide a good increase of outcome scores. The functional suture of the infraspinatus, leaving uncovered the greater tuberosity, in patients with irreparable cuff tear of the lone supraspinatus, give good results in terms of patients satisfaction and in restoring the AHD even at long term follow up. The presence of complication is quite rare and in line with the usual sequelae of a rotator cuff repair.

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Medial patellofemoral ligament reconstruction for recurrent patellar dislocation. Surgical procedures review

M. Ronga
Department of Orthopaedics and Traumatology, University of Insubria, Ospedale di circolo, Varese, Italy.

Tears of the MPFL are often considered the essential lesion of recurrent lateral patella dislocation. Cadaveric sectioning studies have demonstrated that the MPFL provides 50% to 60% of the soft tissue restraint to lateral translation, and the medial patello-meniscal ligament contributes 24%. Pathological conditions such as patella alta, trochlear dysplasia and an increased quadriceps angle from various torsional deformities of both the femur and the tibia can be associated with recurrent patello-femoral dislocation. All these conditions need to be corrected to restore the physiological biomechanics of the patello-femoral joint. Lateral retinacular release, proximal realignment and distal realignment are the most common procedures performed for this purpose. In recurrent patellar dislocation without any predisposing factor, all these non-anatomical surgical procedures have been used. They alter the pre-morbid patellar mechanics, and several studies reported inconsistent outcomes, recurrent dislocations, patello-femoral pain and arthritis in up to 40% of patients. Several reconstruction procedures of the MPFL with semitendinosus, gracilis, quadriceps tendon, adductor magnus, iliotibial band and synthetic grafts have been described. Semitendinosus tendon autografts are the most commonly used reconstruction construct. The different techniques require the fixation of the graft to the patella through bone tunnels loop, anchors, endobutton or sutured to the periosteal and fibrous tissue overlying the patella. The medial fixation to the femur is performed through bone tunnel and interference screw, endobutton, washer or through an osteoperiosteal tunnel under the adductor magnus. Most of the pre-mentioned techniques have shown acceptable medium-term results in the mean of subjective symptomatic improvement and low rate of recurrence in 85% to 93% of the involved cases. At present, there is no clear consensus as to the best method to reconstruct the MPFL. Several questions need to be resolved and in particular: the right position of graft insertion on the patella; the best fixation methods; at which degree of knee flexion the graft must be tensionated and fixed to avoid overtightening and then increased loads on the patellofemoral joint, which in the long term may result in degenerative joint disease; the right position of graft insertion on the femur since several studies have shown that the femoral attachment of the MPFL is not clearly identifiable. Biomechanical data show significant increases in medial patellofemoral contact pressures when MPFL grafts is misplaced as little as 5 mm. Incorrect graft placement accompanied by a short graft increases medial patellofemoral contact pressures by over 50%. In the future, a well controlled and standardised comparison of different surgical techniques is indicated, to assess whether a specific graft or technique is superior to the others.

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New perspectives in rotator cuff tendon regeneration: review of tissue engineered therapies

Roberto Rotini
Responsabile SSD Chirurgia della Spalla e del Gomito
Istituto Ortopedico Rizzoli, Bologna, Italy

Tissue engineering may play a major role in the treatment of rotator cuff tendon lesions through replacement of an injured tendon segment. Tendons have very poor spontaneous regenerative capabilities, and despite intensive remo-

delling, complete regeneration is never achieved and the strength of tendon and ligaments remains as much as 30% lower than normal, even months or years following an acute injury. Tendons seem to be the least complex of the connective tissues, with respect to their composition and architecture, and this leads to the expectation that they would be more amenable to tissue engineered approaches than other tissues. An accurate literature revision was done in order to know the state of the art of tissue engineering therapies in the field of rotator cuff regeneration. The following techniques of tissue engineering were considered: local injection of stem cells or growth factors, gene transfer, in situ tissue engineering and in vitro production of bioengineered tendons to be further transplanted in the lesion site. So far, few experimental or clinical studies have been done on tendon tissue engineering compared to the extensive work on other tissues of orthopaedic interest, such as bone and cartilage. The existing studies are related to the following tissue engineering methodologies: gene transfer, in situ tissue engineering and in vitro production of bioengineered tendons. In our opinion the previously described literature revision showed the necessity for further studies in this area also because of recent advances in biological and bioactive scaffolds. The high incidence of recurrent tendon tears after repair of massive cuff lesions is prompting the research of materials aimed at mechanically or biologically reinforcing the tendon. Among the materials studied upto now, the extracellular matrix (ECM) scaffolds of human origin have proved to be the safest and most efficient, but the current laws about grafts and transplants preclude their use in Europe. In order to overcome this condition in 2006, we started a project regarding the production of an ECM scaffold of human origin which could be implanted in Europe too. In 2009, the clinical study began with the implantation of dermal matrix scaffolds in 7 middle-aged patients affected with large/massive cuff lesions and tendon degeneration. Out of 5 cases, followed for at least 1 year in which the scaffold was employed as an augmentation device, there were 3 patients with complete healing, 1 partial re-tear, and 1 total recurrence. Our experience with production and utilization of human-derived ECM scaffold is only at the beginning. The cases treated are few and with a short follow-up period. One indication we can draw from our initial experience is that the scaffold from human donor is well tolerated. The non industrial production of AHDM used in our study can limit a wide material availability and the impossibility to store the material in operating room can condition its use and diffusion. Other studies may be necessary to produce scaffolds thicker than those currently in use (always with the same low/absent levels of DNA) and with more suitable storage characteristics.
Moreover, it is fundamental to improve arthroscopic implant techniques, to make surgery standardized, reproducible and less time consuming. The absence of adverse inflammatory or septic complications allows to continue this line of research with a prospective controlled study in order to define the real advantages and correct indications offered by scaffold application and the real utility and indications of augmented rotator cuff repair. In the future, scaffolds could be further improved with seeding of cells, growth factors, or genetic therapy techniques.

Treatment of lesions of the rotator cuff

R. Saggini[1], P. Iodice[1], R.G. Bellomo[2]
[1]Department of Neurosciences and Imaging, Faculty of Medicine, University "G.D'Annunzio", Chieti, Italy
[2]Department of Human Movement Sciences, University "G. D'Annunzio ", Chieti Italy

The rotator cuff is the primary dynamic stabiliser of the glenohumeral joint and is placed under significant stress during overhead and contact sports. Mechanisms of injury include repetitive microtrauma, usually seen in the athlete involved in overhand sports, and macrotrauma associated with contact sports. Rotator cuff disease results from numerous causes, including vascular factors, impingement, degenerative processes, and developmental factors. Each of these contributes to the evolution and progression of rotator cuff disorders.
The prevalence of calcification in the rotator cuff is reported to be between 2% and 20% in asymptomatic shoulder joints. The reported prevalence in patients with shoulder pain is up to 50%. The disorder is most common among people between 30 and 60 years of age. The aim of this study is to evaluate the efficacy of a specific rehabilitative protocol, integrated with the administration of a nutritional supplement, in the conservative rehabilitative treatment as well as in post-surgery, in patients with lesions of the rotator cuff.
Between February 2009 till January 2010, we enrolled 80 subjects (44 male, 58.4±19y; 36 females, 59.5±16y), with rotator cuff syndrome with calcification of the shoulder, diagnosed through clinical examination and investigative instruments (X-ray, echography or NMR).Two groups were set up following different therapeutic courses, in relation to the choice of the subject to undergo the conservative treatment (Arm A n=30) or the surgical one (Arm B n=50). In Arm A (randomized into three homogenous groups A1, A2, A3) the study included the association of therapy with ESWT (shock waves) with the proprioceptive Multi Joint System, for rehabilitating the joint movement and muscle strength of the shoulder, and a specific nutritional supplement to reduce the pain and conserve the cartilage tissue. In Arm B (randomized into two groups, B1 and B2), who had undergone rotator cuff operations and acromionplasty for non-massive lesions without important gleno-humeral instability, with either open or arthroscopic procedures.

The analysis of the results of Arm A show a decrease in pain perception: in group A1: 45% reduction of the VASwhere the supplement was given; in Group A2: 22% reduction of the VAS; in Group A3: 45% reduction of the average VAS. The results of the articular ROM in groups A1 and A2 showed a greater increase in the articular range with the use of MJS.
Arm B, in both groups an decrease of pain perception 73% Group B2 and 70% Group B1. An improvement infunction (49% Group B2 and 36% Group B1) and in strength of forward flexion (39% Group B2 and 30% Group B1). In Group B1, 84% of the patients declared to be satisfied and improved and 16% were dissatisfied; in Group B2, where the nutritional supplement was given, 92% were satisfied and 8% were dissatisfied.
In conclusion, we retain that in cases of rotator cuff syndrome, an integrated rehabilitative approach, whether conservative or post-surgical, directed at taking total control of the patient, must observe particular attention to the optimization of the articular tissular metabolic balance in order to favour better functional recovery.

Osteoporosis and muscles changes. The connection

Umberto Tarantino
Department of Orthopaedics and Traumatology, University of Rome "Tor Vergata" School of Medicine, Rome, Italy

The widespread increase in life expectancy is accompanied by an increased prevalence of physical frailty features. Signs and symptoms may include sarcopenia and osteoporosis, reduced exercise capacity, and diminished wellbeing (Dela and Kjaer, 2006).
The term "sarcopenia" is used to indicate the progressive reduction in muscle mass and muscle strength that affects older people, and it is considered one of the hallmarks of the aging process (Crepaldi and Maggi, 2005).
It is strongly associated to bone loss and osteoporosis and causes a large percentage of disability such as increased fall rates, decreased bone strength and decreased exercise tolerance.
The genesis of both sarcopenia and osteoporosis is multifactorial. Several factors that play a role in the origin of osteoporosis are thought to contribute in causing sarcopenia. During aging, the loss of muscle mass and strength is due to progressive atrophy, loss of muscle fibers, and reduction in muscle capacities. Although these changes are, to some extent, the consequence of the reduced level of physical activity, they can also be influenced by biological processes, including infiltration of fat and connective tissue into the muscle, changes in muscle metabolism, insulin resistance, reduced levels of specific hormones, oxidative stress accumulated during the lifespan and catabolic stimuli from chronic inflammation (Kanis et al., 2008; Pereira et al., 2009).
A common etiology may be responsible for a positive association between osteoporosis and sarcopenia, that may act together in the genesis of disability, imposing a relevant economic burden on healthcare services (Kanis et al., 2008).
Prevalence of sarcopenia in hip-fracture subjects is largely unknown, and the association between sarcopenia and osteoporosis has not been defined in patients who sustain a fracture of the hip.
We investigated the association between sarcopenia and osteoporosis in a sample of women who sustained a hip fracture in vastus lateralis biopsies. Muscle fibers were counted, measured and classified by ATPase reaction.
Our study shows that in osteoporosis there is a preferential and diffuse type II fiber atrophy, that seems to be related to disease severity and influenced by inflammatory factors.
In conclusion, there is great need for focused yet integrated research in this area. Understanding the mechanisms that lead to age-associated bone and muscle loss can be the key to developing effective interventions of prevention, cure and rehabilitation that can improve the quality of life of an increasing number of older people.

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Percutaneous fibrolysis in muscles injury

Vittorino Testa
Olympic Centre, Angri, Salerno, Italy

The fibrous scar is one of the most common problems in athletes as they represent the most frequent complication after muscles injuries. The technique of diacutaneous fibrolysis is a conservative therapy, proposed over 40 years ago by Kurt Eckman, a Swedish pysical therapist, which collaborate with James Cyriax during the years following the Second World War. He realized that the manual palpation was not precise and sometimes did not reach the adherences deeply located. So that was the reason why he developed "hooks" in order to have a more specific and deeper access to the fibrous tissue. At first this procedure was applied to occipitalgy, epicondilalgy and persistent Achilles tendinopathies. Actually the technique has been indicated to pain syndromes caused by fibrotic scarring processes in sport medicine. The contraindications of this technique are:
- Badly trained therapist
- Too aggressive therapist
- Any cutaneous bad condition as diaphanous, hypotrophic, ulcerous skins and the dermatosis, etc.
- Any circulatory systems trophic bad state as capillary fragility, varicose vain, adenoma presence, etc.
- Patient treated with anticoagulant
- Use the technique in children and elderly

This is a noninvasive technique that consists in the mechanical disruption of adhesions scar tissue, using sharp instruments, which operated in an accurate and precise, acting on the skin without wounds. It is free from complications, and give excellent results, even in refractory cases to any treatment, so it can be seen as often as the only possibility of resolving fibrous adhesions muscle, and allowing the return to full sports activity early and without recurrence.

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Suspensory fixation of graft in anterior cruciate ligament reconstruction

Fabio Treia
Clinica San Luca, Rome, Italy

There exists a trend in ACL reconstruction toward soft-tissue grafts in lieu of the traditional gold-standard BPTB grafts. Soft-tissue grafts have been proven to provide lower patient morbidity at the harvest site, making them an attractive option for surgeons performing ACL reconstruction. Recent advances such as AperFix (Cayenne Medical, Inc.) have greatly improved the fixation of soft-tissue grafts. Until the development of the AperFix technology, soft-tissue ACL reconstruction was perceived to have less-than-acceptable fixation strength and higher graft construct laxity. Fixation strength and stiffness of the construct are the weak links in ACL reconstructions that utilize soft-tissue grafts. Interference screws and cortical buttons have been the gold standard fixation methods for soft-tissue ACL reconstructions, but they both have weaknesses as compared to BPTB ACL reconstruction methods. Based on our initial data and subject follow-up, the Cayenne AperFix® ACL fixation system provides superior validated patient outcomes and no failures due to tunnel widening (or any other reason) after ACL reconstruction utilizing hamstring autograft and/or tibialis anterior allograft tendons.

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Subscapularis arthroscopic repair: the update

Andrea Vitullo[1], Rendine Mario[2], De Biase Carlo[3]
[1]Ospedale "S.Pietro" Fatebenefratelli, Roma, Divisione Ortopedia e Traumatologia
[2]Ospedale "Vannini", Roma, Divisione Ortopedia e Traumatologia
[3]Ospedale "S.Carlo di Nancy", Roma, Divisione di Ortopedia e Traumatologia

Tears of subscapularis tendon are now more frequently recognized; this has been facilitated by shoulder arthroscopy approaches, providing the opportunity to see the articular side of the rotator cuff.
The subscapularis tear is often associated with tears of post-superior rotator cuff tendons but isolated subscapularis tendon tear can be also.
Results of athroscopic repair of isolated subscapularis tendon tears have not been widely studied and there are few studies about subscapularis arthroscopic treatment, outcome, evaluation of function with subscapularis strength quantification, integrity.
One of the main challenges to arthroscopic subscapularis repair is the small anterior space overlying the subscapularis tendon: the subcoracoid space. In this area there is not space like in the subacromial area; the visualization is limited; the instrument manipulation and knot tying can be more difficult.
In case of cronic subscapularis tendon tear the tendon is very retracted and is not easy to identify it; the scar tissue is behind the coracoid and medially, close to neurovascular bundle; the surgeon has to be confident with "the comma sign", with the brachial plexus and vessels in this anatomic area. The superior gleno-humeral ligament and coracohumeral ligament (comma sign) are retracted in junction with the supero-lateral border of the retracted subscapularis tendon; is important to follow the comma as a guide to reach the sub-scapularis tendon and perform the release.
Extensive tear create more technical problems requiring an extra-articular approach; in case of severe tear is important to visualize the subscapularis tendon along its main axis from above, on a lateral approach allowing the intra and extra articular parts to be controlled, so as to check the reduction achieved by traction wire and anatomic fixation by anchors and sutures. The useful portals are posterior, lateral, antero-lateral, accessory antero-lateral, ant-superior portals.
The tendon repair to the bone start from upper part of sub-scapularis and it proceed distally to the inferior part in the bursal side.
The subscapularis repair is very important for the function of the shoulder; in cases of associated post-superior cuff tear, if the subscapularis tendon is repaired initially, the post sup cuff repair can be more easily and more reliable achieved.
In cases of severe massive (ant-post-sup) cuff tear functional repair (subscapularis and infraspinatus) can be a good solution according to the Burkhart theory.
The subscapularis tendon can be repaired also in cases of fatty degeneration because of its tenodesis effect as an anterior restraint.
Biceps tenotomy or tenodesis is often required in subscapularis repair because of its degeneration and or instability.
Arthroscopic repair of subscapularis tendon achieves substantial improvement of shoulder function, pain relief and a low rerupture rate; despite excellent clinical results, a significant post-op subscapularis strength deficit persist.
Based on the results in the literature arthroscopic repair of subscapularis for isolated or associated post-sup tear is recommended.

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Epidemiology of muscle strain in soccer

Piero Volpi[1], Melegati Gianluca[2]
[1]Istituto Clinico Humanitas – IRCCS - Unità di Chirurgia del Ginocchio e Traumatologia dello Sport, Milano
[2]Physioclinic, Milano

In Europe, Soccer is responsible for 50% of all sports-related injuries as estimated by different studies. Among the overall injuries, in professional football, muscle strains are the more frequent, representing 20-30%.
Lack of training is one of the several proposed causes of muscle strains. The training/match ratio (3, 6) shows that there is a little time for training in relation to many matches, especially as training sessions before and after matches obviously cannot be regarded as "training" because they mainly concentrated on the preparation for the game and therefore are usually tactical or simply tiring.
Other proposed causes of muscle strains are insufficient warming up, excessive fatigue, strength imbalances, flexibility deficiencies, muscle weakness and insufficient rehabilitation.
There are several causes of the recent rise in the incidence of football injuries: as compared with the past, play is faster (quicker movements and actions), changes in the quantity and quality of work and the number of weekly sessions required by training methods, technical and tactical innovations. The increasing use of close marking, offside, double marking and other tactics applied at the maximum intensity both in training and during the matches evidently carries the risk of both acute and chronic overuse injuries. Modern football, unlike the past, is marked by a faster play and this necessarily translates into an increase in the intensity of practices. This may justify an increase in the percentage of muscle strains occurred during practice compared to the scientific literature. 50% of muscle strains occurred during the training sessions whereas 50% occurred during the match.
In the professional sector, the total number of official matches, the engagements during the course of the week, the over-hurried and over-intense beginning of the season and the impossibility of carrying out with regularity and continuity the pre-established training programs are possible concurrent causes of the determination of accidents. Otherwise, the high technical level of the players, the good conditions of the playing and training fields are considered as preventive factors.
The football players of this study represent an elite population that is constantly monitored by the team's medical sector coordinated by the team doctor and composed of consultant physicians of different areas of specialization, physiotherapists and trainers.