6. RECURRENT ANTERIOR INSTABILITY FOLLOWING FAILED SURGICAL REPAIR: ALLOGRAFT RECONSTRUCTION OF LARGE HUMERAL HEAD DEFECTS. ***Anthony Miniaci, MD, FRCSC***

Objective: To perform a retrospective review of seven patients with 8 humeral head impression defects who had previously failed instability repairs for ongoing anterior traumatic instability. Humeral head impression defects are unusual cause for recurrence of anterior instability following a soft tissue repair. The purpose of this paper was to report our experience and clinical results with the use of massive humeral head allograft for the treatment of structural defects in patients with failed instability repairs. Over a three-year period, 7 patients with 8 shoulder problems who had failed previous soft tissue repair for anterior shoulder instability and were treated with matched humeral head allografts for humeral head impression defects. The patients underwent a retrospective subjective and objective evaluation including pre and post operative imaging to assess incorporation and viability of the humeral head grafts. The patients were evaluated using SF 36 for general health status as well as the constant shoulder scale to assess shoulder function and a specific outcome scale in the Western Ontario shoulder instability index (WOSI).

Results: 7 patients followed an average of 28.4 months (18-48 months) with reconstructed articular defects (average 30%) were reviewed. All patients had multiple dislocations and an average of 2.3 prior operative procedures. Time from first dislocation to time of surgery was six years. None of the patients had any instability in the first at 2 years, all patients returned to work. Average constant score was 78.5, SF36 was similar to a normative population and the WOSI scale improved from a preoperative scope of 1896 to a postoperative score of 789. Scans did not demonstrate any evidence of graft collapse. There was early evidence of osteoarthritis in 3 patients, present both pre and postoperatively and no hardware complications were encountered.

Conclusion: We found patients with large humeral head impression defects (25%) who had failed standard soft tissue instability repairs, can

achieve a successful surgical result by correcting the structural pathology in the humeral head with a massive humeral head allograft.

7. THE CHONDROMALACIA IV° OF THE CENTRAL PART OF THE HUMERAL HEAD OSTEOCHONDRAL AUTOGRAFT TRANSFER (OAT) KNEE-SHOULDER. ***Robert Smigielski, MD****; Andrzej Mioduszewski, MD; Robert Swierczynski, MD; Grzegorz Adamczyk, MD, PhD*

Objective: To present in what way we can manage chondral lesions of the humeral head.

Methods: 43 years old male, recreative windsurfer had a right clavicle fracture 10 years ago. He was treated conservatively. The fracture was heated up with angulation and shortening. At the first clinic visit he demonstrated impingement syndromes. We performed the shoulder arthroscopy. During the procedure we found chondromalacia IV° of the central part of the humeral head with exposition of the subchondral bone. At the same time we performed the acromioplasty. After 3 months we made osteochondral autograft transfer from the ipsilateral knee to the shoulder. The extremity was immobilised in adduction and internal rotation for 4 weeks. The brace was removed only for exercises. The rehabilitation process started next day after the operation.

Results: Now patient returned to the previous activity without any complaints. The follow-up time from the second procedure is 10 months.

Conclusions and significance: Osteochondral autograft transfer knee-shoulder is a demanding procedure but seems to be good way of treatment of the humeral head cartilage lesions in some patients.

8. SURGICAL TREATMENT OF RESISTANT LATERAL EPICONDYLITIS. ***Nahum Rosenberg, MD, M.Orth.****; Ian Henderson, FRACS*

Objective: Lateral epicondylitis resistant to conservative treatment is a rare yet disabling condition. When diagnosed it should be treated surgically. We report here our experience with a group of patients with long-standing resistant lateral epicondylitis that were treated by excision, release, repair and reattachment of the common extensor tendon origin, and were clinically followed for 2-9 years.

Methods: Nineteen consecutive patients were selected for surgery due to resistance to conservative treatment of lateral epicondylitis. The patients were re-evaluated regarding pain and functional outcome of the surgical treatment. The parameters that were investigated included verification of timing of recovery from pain, recovery of subjective strength in the forearm musculature and return to, or change in, previous professional and sports activities.

Results: Eighteen patients reported on pain disappearance at average three months from surgery. Subjective strength in forearm and hand was regained at average four months postoperatively. One patient had no improvement in symptoms for 24 months after the operation and considered a failure. Only two patients actually altered both professional and sports activities after their surgery.

Conclusion: We have chosen a therapeutic approach, that should treat the local pathology most effectively and will require less extensive surgery. The essential conditions for success of the presented therapeutic approach should be a careful patient selection for surgery by using criteria of long-standing symptoms resistant to conservative treatment, a meticulous attempt to exclude other regional pathologies and adequate excision of the pathological tissue in the common extensor origin. We show that by following these diagnostic and surgical rules a high success rate in treatment of resistant lateral epicondylitis is anticipated.

9. THE "JOINT JACK": REPORT OF A NEW ESSENTIAL TECHNIQUE FOR ELBOW ARTHROSCOPY. ***Ronald M. Selby, MD****; Stephen J. O'Brien, MD; Anne M. Kelly, MD; Mark Drakos*

Visualization and access are of fundamental importance in arthroscopy including arthroscopy of the elbow. A new technique not previously described in the literature improves both of these factors for key areas within the elbow that would otherwise be inaccessible. We feel this technique is essential for a full arthroscopic viewing of the elbow.

Elbow arthroscopy has become a commonly practiced technique over the past 20 years. Although not without risks, excellent visualization of intra-articular structures and access to intra-articular areas for problems such as loose bodies, adhesions, osteophytes, and synovitis is possible. This report encompasses a description of a technique utilizing leverage to gain improved arthroscopic visualization and access for surgery within the ulnohumeral and radiocapitellar joints.

Arthroscopy of the anterior portion of the elbow is carried out first in the standard manner. While performing arthroscopy of the posterior elbow the arthroscope in the direct posterior "triceps splitting" portal after a spinal needle has assured intra-articular positioning. A tapered, blunt trocar is then placed via a portal just lateral to the lateral aspect of the triceps. Spinal needle localization can prove valuable in the event that the anatomy or pathology dictates that an additional accessory portal be utilized. The cannulas are then introduced over pins to further help assure accuracy and safety. The tapered, blunt trocar is slowly advanced, gently prying open the articular surfaces and thus gaining improved visibility and access to the ulnohumeral joint. The trocar is then used to lever apart the surfaces and thereby allow additional increased space for visualization of the ulnohumeral joint. Following inspection the arthroscope is then slipped into the ulnohumeral joint and itself used to lever apart the articular surfaces. The joint separation gives a unique view of the ulnohumeral and radiocapitellar area which accesses a site which otherwise remains inaccessible.

10. THE EFFECT OF POSTEROMEDIAL OLECRANON OSTECTOMY ON THE BIOMECHANICAL PROPERTIES OF THE ULNAR COLLATERAL LIGAMENT (UCL) OF THE ELBOW. ***B. Rodney Comisar Jr., MD****; Walter R. Lowe, MD; David M. Lintner, MD; Phillip Noble, PhD*

Question: With repetitive throwing, large valgus forces at the elbow can cause posteromedial olecranon osteophyte formation and posterior impingement. Treatment involves decompression of the posterior joint and has been associated with excellent short-term results with a high return-to-sport rate. However, Andrews demonstrated a 41% reoperation rate in baseball players undergoing arthroscopic decompression, with a significant percentage requiring UCL reconstruction. The goal of this study was to determine if a posteromedial olecranon ostectomy is a primary destabilizing procedure in throwers with posteromedial spurs.

Methods: Nine fresh-frozen elbows were dissected, fixed in dental plaster, and placed in the servohydraulic testing machine in the gravity valgus position at 70° of elbow flexion. Specimens were preloaded (10N) and preconditioned (additional 25N). An infrared motion system was used to record 3-D movement of the specimen. Micro-strain gauges measured length changes in the two bands of the anterior bundle of the UCL. A progressive valgus loading cycle (25N increments to 150N) was performed. An 8 mm posteromedial olecranon osteotomy was then performed and the loading cycle repeated. Statistical analysis involved paired t-tests.

Results: A trend towards increased medial joint space opening at all torque levels (3.3 - 16.5 Nm) in the intact versus osteotomized specimens was noted; however, no statistical significance was found. Stiffnesses in the two bands of the anterior bundle were comparable, pre- and post-osteotomy, at all torque levels. There also was no difference in stiffness values between the anterior band and posterior band at all torque levels in the intact and osteotomized specimens. There was no difference in creep and strain in the two bands, except in the posterior band at the highest torque level in the osteotomized (versus the intact) specimen.

Conclusions: Posteromedial olecranon ostectomy does not affect the biomechanical properties of the UCL under valgus load at 70° of flexion but may unmask pre-existing laxity. There is no difference in the contributions of the anterior and posterior band of the anterior bundle to stability under these conditions. Limitations center on how well the model simulates the stresses of throwing; the effect of pre-existing UCL laxity; and whether the osteotomy of native olecranon may overestimate the surgical resection.

11. TREATMENT OF RADIOULNAR SYNOSTOSIS FOLLOWING DISTAL BICEPS TENDON REPAIR. ***Jason L. Koh, MD*** *(a – Cleveland Clinic); Thomas Anderson, MD*

Objectives: We describe treatment of heterotopic ossification (HO) and limited movement after distal biceps tendon repair.

Materials and Methods: Three patients were referred for loss of motion following 2-incision distal biceps tendon repair. All had been immobilized for 4-6 weeks. Progressive loss of rotation was noted over 4-8 weeks, with complete loss by 3 months. Patients had normal flexion and extension. Brooker IV HO was noted between the radius and ulna.

Treatment: Following the previous dorsal incision, tissue was bluntly dissected to the synostosis. Soft tissue was debrided with electrocautery, and HO was carefully removed to the level of normal bone. Full rotation was attained intraoperatively. Patients were treated with indomethacin or radiation, and immediate motion was encouraged.

Results: Average follow-up was 28 months. Average pronation was 65° (45°-80°) and supination was 70° (50°-90°). Average arc of 135° (90°-170°). All patients were able to return to chosen activities, with modifications for 1 patient. All patients were satisfied. There were no neurovascular complications.

Discussion: Radioulnar synostosis after distal biceps repair is a rare but serious complication. All patients in this series had extensive dissection along the ulna and prolonged immobilization, which may have contributed to this complication. Patients were successfully treated with excision of the synostosis followed by postoperative prophylaxis against recurrent HO and early motion. In the operative treatment of biceps tendon ruptures, we recommend limiting or eliminating dissection along the ulna; and early active/active-assisted motion.

12. ARTHROSCOPIC REPAIR PERIPHERAL TFCC TEARS. ***Michael R. Redler, MD****; Steven P. Fries, PA-C; Beth Roros, CHT*

Objective: Evaluation of new arthroscopic technique for repair of peripheral TFCC tears (TFCC -triangular fibrocartilage complex).

Method: A series of 15 patients with peripheral TFCC tears underwent a wrist arthroscopy and repair of peripheral tears with a newly developed technique.

Results: Patients were followed for at least a years period of time. They were evaluated using the Mayo Modified Wrist Score. Postoperative results revealed that they had a Mayo Modified Wrist Score of 95 with a range of 80-100. One patient required removal of a painful subcutaneous suture knot, and one patient had a superficial infection that cleared with antibiotics.

Conclusions: In recent years appreciation of the role of TFCC tears and ulnar sided wrist pain has significantly increased. Severe twisting and loading injuries about the wrist are commonly responsible for tears of the TFCC. These patients commonly will present with ulnar sided wrist pain, pain with extremes of supination and pronation, as well as pain with repetitive activity. Treatment options in the past have included casting, physical therapy, and arthroscopic or open debridement of the TFCC tear. In recent years it has become more clear that peripheral tears of the TFCC have a reasonable blood supply and therefore are candidates for repair. The technique described here using a shuttle relay system with spinal needles has produced excellent results for repair of these peripheral TFCC tears. Wrist arthroscopy had been done using a wrist arthroscopy tower and a 2.7 mm wrist arthroscope. Repair was done using spinal needles, shuttle relay, and a PDS suture that is placed in a mattress type fashion. The PDS suture can be tied down through the puncture wound to the capsule in a secure fashion. These patients were casted for six weeks and then went through a short course of physical therapy with excellent results. Presentation will include review of literature, review of surgical technique, and evaluation of patient population as well as an illustrative case.

13. THE ANATOMY OF THE POSTERIOR ASPECT OF THE KNEE. ***Robert F. LaPrade, MD****; Patrick Morgan, BS; Steinar Johansen, MD; Lars Engebretsen, MD, PhD; Fred A. Wentorf, MS*

Objective: The purpose of this study was to provide a detailed description of posterior knee anatomy, including both recognized structures and those not currently described in the literature.

Methods: This was accomplished by careful dissection of the posterior aspect of twenty fresh frozen cadaveric knees. Structures of interest were dissected out, measured according to length, width, and/or distance to reproducible landmarks, and photographed.

Results: The semimembranosis tendon and its posterior knee expansions had a consistent anatomic pattern. The direct arm of the semimembranosis at its insertion was 13 mm wide, with 6.7 mm contributing to the oblique popliteal ligament (OPL). The average length of the OPL was 50.9 mm and its width was 10.3 mm at its medial expansion and 12.9 mm at its lateral attachment. Contrary to some anatomy textbooks, which describe the OPL lateral attachment to be on the posterior aspect of the lateral femoral condyle, its lateral attachment was on the meniscofemoral portion of the posterolateral capsule. This was confluent with the plantaris muscle attachment and the lateral aspect of a bony or cartilaginous fabella. A proximal posterior capsular arm of the semimembranosis attached both to the posterior capsule and the short head of the biceps femoris. The semimembranosis had two distal tibial arms, one medial and the other lateral, which formed a posterior fascial expansion over the popliteus muscle. The medial arm was larger, with a total length of 84.3 mm. A posterior popliteal aponeurosis, which averaged 38 mm in length, was identified which connected the posteromedial knee capsule to the medial border of the popliteus musculotendonous junction. The ligament of Wrisberg, plantaris muscle, and posterior semimembranosis bursa were present in all specimens.

Conclusions: In conclusion, we believe that this study increases the understanding of the detailed anatomy of the posterior knee. While most of these structures had described before, many were only in pictorial form and exact anatomic locations were incorrectly described or illustrated. We believe this study yields information which can lead to further biomechanical analysis of the importance of these structures.

14. BIOMECHANICAL EVALUATION OF RECONSTRUCTION STABILITY WITH ONE AND TWO BUNDLES OF GRAFT IN ISOLATED POSTERIOR CRUCIATE LIGAMENT INJURY. ***Alexandre Kokron****; Arnaldo Hernandez, MD; Gilberto Camanho, MD; Marco M. Amatuzzi, Prof.*

The first purpose of this study was to compare the passive stability at the end of posterior cruciate ligament (PCL) reconstruction with one and two bundles of graft. The second purpose was to compare the stability provided by quadriceps tendon graft with hamstrings tendons graft.

The authors used 14 fresh-frozen human knees from seven cadavers (mean age 47 years).

From each pair of knees, one was reconstructed with double bundle graft technique, and the other one was reconstructed with single bundle graft technique. In each knee, a 10 millimeter quadriceps tendon graft was used first, and then a four-strand semitendinosus and gracilis tendons graft was used. Stability was tested four times in each knee: with intact ligaments, after creating an isolated PCL injury, after reconstruction with quadriceps graft, and after reconstruction with hamstrings graft.

Stability was evaluated using an electromechanical machine and was based on the posterior displacement of the tibia and stiffness to posterior tibial displacement. Statistical analysis was performed by ANOVA with repeated measures.

PCL reconstruction could not restore the stability provided by the intact ligament, mainly at 60 and 90 degrees of knee flexion.

The comparison between single and double bundle reconstruction stability did not show statistical difference, with both quadriceps and hamstrings grafts reconstruction.

There were some differences between stability of quadriceps and hamstrings grafts reconstructions which, although statistically significant, were small in magnitude and just in some knee flexion angles, so there was no definitive biomechanical advantage of one graft as compared to the other.

15. ARTHROSCOPIC PCL RECONSTRUCTION WITH TWO-BUNDLE AUTOGRAFTS. ***Pascal Christel****; Patrick Djian*

Recent biomechanical studies have shown the posterior cruciate ligament (PCL) exhibits 2 main bands, antero-lateral (AL) and posteromedial (PM), having clearly distinct biomechanical function in the posterior knee stability. This paper presents a study of a continuous series of 33 patients with posterior instability treated by arthroscopically-assisted PCL reconstruction using a two-bundle autograft, either patellar or quadriceps tendon. A transtibial tunnel technique with two femoral tunnels located at the center of the PM and AL bundles was used. The graft fixation was insured by 3 interference screws. The AL band was taught at 70° of flexion and the PM band in extension. Secondary restrains were reconstructed as necessary. The series includes 23 males and 10 females, with a mean age of 28 (24-42). There were 9 straight posterior, 13 combined PPL, 7 PPM, and 4 AP instabilities. Simultaneous to PCL reconstruction the following procedures were associated: 6 PM reconstructions; 12 PL reconstructions and 6 HTO. The mean follow-up was 24 months (12-69). 25 patients had a follow-up over 12 months. Patients were evaluated with the IKDC scoring system and stress x-rays.

IKDC score	Preoperative	Final follow-up
Activity level	2II, 6III, 25IV	4I, 12II, 5III, 4IV
Subjective assessment	10C, 23D	2A, 18B, 5C
Symptoms	2B, 8C, 23D	3A,18B, 4C

The average side-to-side posterior drawer difference at 70° of flexion was 11.1±4.8 mm (range 6-25 mm) preoperatively and, 4.9±3.1 mm (range 0-12 mm) postoperatively, a 59% gain. There was no complication of the surgery. The laxity gain decreased in case of associated postero-lateral instability. There was no effect of the disability time on the final result. There was a relationship between the post-operative activity level and the residual laxity.

Conclusion: Arthroscopic reconstruction of the PCL allows a precise placement of the tunnels and attempting to reconstruct both major bands of the would best attempt to reconstruct the normal anatomy, geometry, and function of the PCL through full knee range of motion.

16. CLINICAL AND RADIOLOGICAL RESULTS AFTER PCL RECONSTRUCTION WITH THE AUTOLOGOUS QUADRICEPS TENDON. ***Jacques Menetrey, MD****; Mathieu Assal, MD; Olivier Siegrist, MD; Daniel Fritschy, MD*

Introduction: The posterior cruciate ligament (PCL) is less frequently injured than the anterior cruciate ligament. However, PCL reconstruction allows only partial restoration of the initial posterior laxity. The aim of this study is to assess the clinical and radiological results of a consecutive series of PCL reconstructions using autologous quadriceps tendon.

Material and methods: 13 PCL reconstructed knees in 12 patients [(n=13 knees) (mean age: 27.5 (18-39) years, M: 10, F: 3, Mean FU: 3.3 (2-6) years, isolated PCL: 8, PCL+ACL: 4, PCL+postero-lat.: 1)] were performed with an autologous transplant of quadriceps tendon - patellar bone plug 11 mm wide by 10 cm long. The technique was "single bundle" performed through two incisions and designed to reconstruct the antero-lateral bundle; Fixation was secured with interference screws on the femoral and tibial sides. In addition, the tibial sutures were fixed to an AO screw-post. A standard post-operative rehabilitation program was used. All the knees were reviewed and assessed with the IKDC score. Posterior laxity was evaluated by axial and stress radiographs performed with the pcl-Press.

Results: Using the IKDC score: 1 knee was rated normal, 7 almost normal, 4 abnormal, and 1 severely abnormal. Clinical examination revealed 8 knees with a postero-lateral rotatory instability. The mean posterior laxity was 11.3 (7-17) mm as measured radiologically.

Conclusions: This study confirms the difficulty in restoring the posterior stability with a PCL reconstruction using an autologous quadriceps tendon. The use of stress radiography in the assessment of posterior laxity leads to critical evaluation and we recommend its use in the assessment of any PCL injury.

17. RESULTS OF POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH FULL ARTHROSCOPIC TECHNIQUE: 2- TO 8-YEAR EVALUATIONS. ***Fabrizio Margheritini, MD****; Gianluca Camillieri, MD; Luca Mancini, MD; Pier Paolo Mariani, MD*

Aim: To present our long-term experience in posterior cruciate ligament (PCL) reconstruction with a full arthroscopic technique. A critical review about the most effective evaluation system is also performed.

Materials: We retrospectively studied 50 patients with a PCL injury who underwent arthroscopic reconstruction with a bone patellar tendon bone autograft. All patients presented pre-operatively a +++ of posterior drawer. We excluded from this study patients with PCL tibial avulsion or with combined cruciate ligaments rupture. A complete IKDC, HSS and Lysholm knee scoring scale have been used in order to evaluate these patients. Moreover stress radiographs were obtained in all cases.

Results: At an average follow-up of 46 months (range: 24-100 months) the average knee ligament evaluation score was 87 (range 51-100) in the HSS, while the IKDC evaluation form shows that 10% of patients were graded A, 57.5% patients were graded B, 20% were graded C and 12.5% were graded D. Among these the 95% of patients were graded A or B in the objective scale, while in the functional scale more than 72.5% were graded A or B. The average Lysholm knee score was 94 (range 66-99) and the stress radiographs showed an average posterior displacement of 7 mm side to side (range 0-12). We have not reported any surgical related or post-operative complications among the patients studied.

Clinical Relevance: These results suggest that the full arthroscopic technique achieves satisfactory results without surgical related complications. Harvesting of patellar tendon autograft has never influenced the surgical time or produced related complications. We want also to underline that it could be difficult to assess with a single evaluation system the real outcome of this procedure. In our opinion, it is recommendable to perform a clinical and functional evaluation with at least two systems, integrating those with stress radiographs examination.

18. PCL-JACK: A DYNAMIC ORTHOSIS FOR A SECURE REHABILITATION AFTER POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION. ***C.B. Marti****; E. Gautier; A.J. Schuster; R.P. Jakob*

Introduction: There is an overall agreement that the reconstruction of the PCL leads to an average loss of stability of 50%. The reason for this postoperative loss of stability is a too rapid rehabilitation, a flexion of over 90° in the first weeks already and the constant exposure of the transplant to gravity in its weak phase of revascularisation during the first postoperative months.

Method: To avoid the immobilization in a cast we have developed a system with a dynamic anteriorly directed force that prevents a posterior translation. The anterior translation force is exerted from two lateral springs, fixed at a femoral orthosis and is transmitted to the tibia via a tibial orthosis. We have treated 7 patients with a mean age of 28 years (14-38 years) with the PCL-Jack. The patients were treated with the system for 5 months. The mean follow-up was 6 months (5-7 months). Measurements of the stability were performed with the Rolimeter (Aircast®) and axial x-rays (Puddu).

Results: Using the total sagittal translation measured at 25° and 80° of flexion using the Rolimeter we gained an average of 6.8 mm (from 16 mm preoperative to 9.2 mm postoperative) and 9 mm (from 17.5 mm preoperative to 8.5 mm postoperative). Using the side to side difference of the posterior sag on the Puddu view we gained an average of 9 mm (from preoperative 11.8 mm to postoperative 2.8 mm). The mean loss of the postoperative flexion was 17° (0°-50°). The extension did not change.

Conclusion: This relatively well tolerated system maintains anterior translation of the tibia regardless of precise placement of the rotational center and allows healing without gravity-induced stretching of the graft. The treatment should be continued for 5 months to meet the slow process of remodeling.

19. ECCENTRIC CALF-MUSCLE TRAINING IS A GOOD TREATMENT MODEL FOR PATIENTS WITH PAINFUL CHRONIC ACHILLES TENDINOSIS. ***Hakan Alfredson****; Ronny Lorentzon*

Purpose: Eccentric calf-muscle training has in a prospective pilot study including a relatively small group of patients with painful chronic Achilles tendinosis located at the 2-6 cm level in the tendon been demonstrated to give very good clinical results. This report aimed to investigate the clinical results of this treatment model on a larger group of patients that were sent to our clinic for surgical treatment.

Material/Method: 119 tendons in 98 patients (66 men and 32 women) with a mean age of 44 years (range 33-72) and a long duration of symptoms from chronic Achilles tendinosis located at the 2-6 cm level in the tendon (verified with ultrasonography), were treated with eccentric calf-muscle training for 12 weeks. The loading during training was gradually increased, and the patients were told to continue to do their exercises despite experiencing pain in the tendon. The amount of pain during activity (running, walking) was recorded on a VAS scale, before and after treatment.

Results: 85 patients (103 tendons) were satisfied and back to previous (before injury) activity level (running, walking) after the 12 week training regimen. The amount of pain during activity (recorded in mm, at a VAS-scale) decreased from 72 to 8 mm (12 weeks). 13 patients (16 tendons) were not satisfied and therefore surgically treated.

Conclusions: Treatment with eccentric calf-muscle training has shown good results in a large group of patients with painful chronic Achilles tendinosis. Only 13% of the tendons needed surgical treatment.

Significance: We recommend that eccentric calf-muscle training is tried before surgical treatment on patients with painful chronic Achilles tendinosis located at the 2-6 cm level in the tendon.

20. HISTOLOGY OF ACHILLES TENDON RUPTURES: A COMPARISON WITH UNRUPTURED TENDONS. ***N. Maffulli****; V. Barrass; S.W.B. Ewen*

We studied biopsies from the Achilles tendon of patients undergoing open repair for a subcutaneous rupture of their Achilles tendon ($n=38$, 27 males, 11 females, mean age 45.3 $\pm$ 13.8 years) and specimens of Achilles tendons from individuals with no known tendon pathology ($n=46$, 43 males, 3 females, mean age 64.2 $\pm$ 9.7 years). We hypothesised that, if aged non-ruptured Achilles tendons showed signs of degeneration, this could be responsible for the increased risk of rupture starting from middle age. Histological examination was performed using haematoxylin-eosin and alcian blue/periodic acid Schiff stained slides. The slides were interpreted using a semi-quantitative grading scale assessing fibre structure; fibre arrangement; rounding of the nuclei; regional variations in cellularity; increased vascularity; decreased collagen stainability; hyalinisation; glycosaminoglycan. We calculated a pathology score giving up to three marks per each of the above variables, with 0 being normal, and 3 being maximally abnormal. All the histology slides were assessed twice in a blinded manner, the agreement between two readings ranging from 0.56 to 0.87 (Kappa statistics). The score of ruptured tendons was significantly greater than the average score of normal tendons (20.5 vs. 6.5) ($p<0.001$), and all the variables showed significantly higher degeneration in the ruptured tendons ($0.05<p<0.001$). Normal Achilles tendons, even at an advanced age, and ruptured Achilles tendons are clearly part of two distinct populations. Degeneration is not a feature of tendons from healthy aged individuals.

21. SURGICAL TREATMENT VERSUS NON-SURGICAL TREATMENT FOR ACHILLES TENDON RUPTURE. ***Michael Moller****; Tomas Morin; Karin Lind; Jon Karlsson*

PURPOSE: The purpose of the present study was to compare surgical and non-surgical treatment for Achilles tendon rupture.

METHOD: In a prospective, randomised multicenter study, 112 patients between 18 and 65 years of age (99 men and 13 women) with acute, complete ATR, were included. Treatment consisted of either non-surgical treatment, i.e., eight weeks of plaster treatment or surgical treatment followed by an early functional rehabilitation using a brace. The follow-up period was two years. Evaluation was performed with clinical measurements of tendon width, calf circumference, range of motion and registration of complications. Isokinetic muscle performance tests at the ankle joint and endurance tests with a standardised heel-raise test was performed.

RESULTS: The time to return to work was 54.9 (SD 47.9) days after surgical treatment and 73.4 (SD 56.5) days after non-surgical treatment (n.s). Fifty-four percent in both groups returned to the same level of sports activities as before the rupture. Calf muscle atrophy and increased tendon width followed ATR, regardless of treatment (n.s. between the treatment groups). There were no significant differences between treatment groups in isokinetic muscle tests or heel-raise tests. The rerupture rate was 20.8% after nonsurgical treatment and 1.7% after surgical treatment ($p<0.001$). There were no other major complications following surgical treatment.

CONCLUSION: Surgical and non-surgical treatment for ATR produced equally good functional results if complications were avoided. However, the rerupture rate after non-surgical treatment was unacceptably high.

SIGNIFICANCE: Surgical treatment is recommended after Achilles tendon rupture in healthy persons under 65 years of age.

22. AVULSION FRACTURES OF THE PELVIS AND PROXIMAL FEMUR: A REPORT OF 122 CASES. ***Xavier Juan, MD****; Alejandro Godall, MD; Mercè Molleda, MD; Ramón Cugat, MD*

The aim of this study is to do a clinical and a bibliographic review of avulsion fractures of the pelvic ring and proximal femur. We found that those kind of injuries are not so uncommon as literature says.

We reviewed 21,950 soccer injuries during ten seasons (from September 1990 to May 2000), and we found 122 cases as follow: 48 anterior inferior iliac spine, 35 ischium, 23 anterior superior iliac spine, 8 lesser trochanter, 4 iliac crest, 4 periacetabular rim. The patients ranged in age from 12 to 18 years at the time of initial injury. No females are reported. We've also reviewed the literature and we think our series is one of the largest ever reported.

With an early diagnosis and a directed nonoperative treatment, we achieved excellent results in 120 patients (98.36%). Two patients were operated because of residual symptoms after conservative treatment. Excellent result was considered when the patient could play again at the same level not later than 4 months after the initial injury.

It is important to do an accurate clinical and roentgenographic exam to determine the diagnosis. It is not unusual to see patients initially diagnosed as "groin pull," "torn hamstring" or "hip pointer." Other injuries, even tumors have to be considered.

In conclusion, avulsion injuries around the pelvis are rare, but not so in young athletes. An early diagnosis followed by a carefully directed nonoperative rehabilitation is basic to obtain excellent results.

23. GROIN INJURIES CAN BE PREVENTED – RESULTS OF A RANDOMIZED CLINICAL TRIAL. ***Per Hölmich, MD****; Kim Krogsgaard, MD, PhD*

Objective: Groin pain is a major problem in many sports. The treatment of groin pain in athletes is often very difficult and longstanding.

A resent study by Hölmich et al published in The Lancet showed a very good effect of a training program for adductor-related groin pain in athletes. Based on this program we have developed a program aimed at the prevention of groin pain in soccer. The aim of this study was to compare the preventive program with a control group.

Methods: 55 Danish soccer clubs were randomized by cluster randomization to either the program aimed at prevention of groin injuries (A) or to continued training as before (B). The exposure time, all groin injuries, all other injuries in general and the basic demographic data of all the players were registered.

All injuries were registered on separate data sheets by a physiotherapist, who also examined all players with a groin injury. A standardized clinical examination protocol was used. All data was analyzed before the code was broken.

Results: 1209 soccer players were included. The dropout rate in the two groups was 5 and 6 clubs. The time of exposure was calculated for all players individually. The total incidence of groin injuries was 8%. On basis of the exposure time an intention to treat analysis showed the preventive program (A) to be significantly more effective in preventing groin injuries ($p=0.04$).

Conclusion: Implementation of this preventive program in the soccer training, could be a very valuable tool in order to avoid the difficult and time-consuming groin injuries.

24. FEMORAL NERVE ENTRAPMENT – A RARE BUT IMPORTANT DIFFERENTIAL DIAGNOSIS OF GROIN PAIN IN SPORTS. ***G. Farkas****; A. Goesele; N. Luescher; B. Segesser*

The groin is a very vulnerable region for direct and indirect trauma.

Abduction, extension and external rotation forces lead to great tension to the tendon-muscle units of the groin. Because of their long distance from the rotation center of the hip strains of the adductor, iliopsoas, pectineus and rectus femoris muscle belong to the most frequent traumatic lesions in sports. These type of lesions cause scars and intramuscular fibrotic transformations which can trap different branches of the femoral nerve.

Often the entrapment isn't caused by a single trauma but by repetitive microtraumatas with subfascial bleedings. Direct traumas including operations, e.g., repair if inguinal hernias, can obviously damage the nerve and/or trap him in scar tissue. Although the symptoms are quite typical many patients are treated for a frustrating long time for muscle strain, chronic tendinopathy, inguinal hernia, arthritic hip, and even lesion of the labrum till the diagnosis of femoral nerve entrapment is set. The treatment is always invasive and consists in complete decompression and neurolysis of the nerve.

We will present the results of 16 patients with femoral nerve entrapment in the last 2 years. In a retrospective study we judge the operative result by relief of pain and gain of function (comeback to work and sports). The good results underline the importance of this differential diagnosis in patients with groin pain.

Finally we will show the history, the clinical findings, the operative situs and the aftertreatment of two illustrative cases.

25. LATERAL COLLATERAL LIGAMENT RECONSTRUCTION OF THE KNEE. ***Luca Maria Vena, MD****; Paolo Aglietti, MD; Roberto Buzzi, MD; Francesco Giron, MD*

Objective: We evaluated 13 reconstructions of the lateral ligaments of the knee associated with a reconstruction of the ACL (6 cases) and PCL (7 cases).

Method: In 10 cases the lateral collateral ligament (LCL) was reconstructed using a free semitendinosus tendon (ST) graft passed in the anatomic insertions of the LCL. In 2 cases both LCL and popliteus fibular ligament (PFL) were reconstructed using a tunnel in the fibular head and a Y tunnel in the lateral femoral condyle. In one case only the PFL was reconstructed. All patients were evaluated using the IKDC form. Lateral joint line opening and posterior tibial translation were studied with X-ray stress views with follow-up of 47 months (range 24-70).

Results: In the ACL group all 6 patients were symptoms free. The lateral stress radiographs showed lateral opening of 0-2 mm in 5 knees, and 3-5 mm in 1. In the PCL group 4 patients were symptoms free while 3 reported mild to moderate pain and swelling. Lateral joint opening was 0-2 mm in 6 knees, 3-5 mm in 1 case. External rotation at 30° of flexion was 10° in 2 of the 7 cases with an associated PCL reconstruction and 0° in the remainder. Eleven of 13 patients returned to their preinjury level and 2 returned to one level lower according to IKDC criteria.

Conclusion: This study suggests that the lateral collateral ligament complex can be successfully reconstructed with a free ST graft at the time of ACL or PCL reconstruction.

26. AN IN VIVO ANIMAL MODEL OF _POSTEROLATERAL INSTABILITY OF THE KNEE. ***Robert F. LaPrade, MD****; Fred A. Wentorf, MS; Joshua Crum, BS; Jack L. Lewis, PhD*

Objective: The purpose of this study was to create an *in vivo* animal model of posterolateral knee instability.

Methods: Thirteen skeletally mature New Zealand white rabbits, weighting an average of 4.3 kg (3.9 - 4.8 kg) were used in this study. In one knee of each rabbit, the fibular collateral ligament (FCL) and the popliteus tendon (PLT) were ruptured by placing a metal rod under the structure and pulling laterally. In all cases, a mop-ended tear was created near the femoral attachment of the FCL or PLT. The rabbits were allowed unrestricted cage activity for 3 months. The rabbits were then euthanized and biomechanical testing of the knees was performed. Our biomechanical testing measured the amount of force necessary to produce a uniform amount of displacement. In all cases, the contralateral knee was used as a control.

Results: Grossly, there was no evidence of healing of the FCL or PLT on examination. Biomechanical testing revealed a significant difference in the amount of force to achieve $\pm$ 10 mm displacement for varus at 30° ($p<.0001$), 60° ($p<.006$), and 90° ($p<.01$). At 30°, an average of 5.7 $\pm$ 2.0 N was necessary to result in $\pm$ 10 mm of varus displacement for control knees compared to 2.4 $\pm$ 2.3 mm for operative knees.

Conclusions: We found that the FCL and PLT of the rabbit knee do not heal and there is significant amount of increased motion in varus in the rabbit knee at 3 months after injury. We believe that the rabbit model will prove valuable in the *in vivo* study of posterolateral knee injuries.

27. BIOMECHANICAL ANALYSIS OF TWO RECONSTRUCTIONS FOR INJURIES TO THE POSTEROLATERAL CORNER OF THE KNEE. ***Christopher D. Harner, MD****; Akihiro Kanamori, MD; J. Mi Lee, MD; Danyel J. Tarinelli, MS*

PURPOSE: The objective of this study was to compare the effects of two reconstructions for injuries to the posterolateral corner (PLC) on knee kinematics and in situ forces in the grafts. The techniques studied were biceps tenodesis (BT) and popliteofibular ligament reconstruction (PFL). Because PFL more closely restores normal anatomy, we hypothesized that it would also more closely restore normal knee biomechanics.

METHODS: Ten fresh-frozen human cadaveric knees (40-60 years) were tested using a robotic/universal force-moment sensor testing system. The knees were subjected to a 10 N-m external tibial torque and a 134 N posterior tibial load at full extension, 30° and 90°. Four knee conditions were tested: 1) intact, 2) PLC-deficient (cut popliteus complex), 3) BT, and 4) PFL reconstructions. For BT, the central third of the biceps tendon was fixed at the femoral insertion of the LCL using a screw and soft tissue washer. For PFL, a gracilis autograft was fixed with a biodegradable screw through a transverse fibular tunnel and an endobutton and suture at the femur. The resulting knee kinematics and in situ forces in the PLC or PLC graft were determined for each of the four knee conditions. Statistical analysis was performed using repeated measures ANOVA ($p<0.05$).

RESULTS: Under external torque, PLC-deficiency increased external tibial rotation (ER) by 3° to 7° at 30° and 90° of knee flexion, respectively ($p<0.05$). BT was unable to restore these values to intact knee levels except at full extension, while ER for PFL was not different from intact except at 30° ($p>0.05$). No differences could be demonstrated between the in situ forces in the two grafts and the intact PLC at any flexion angle ($p>0.05$). Under the posterior tibial load, PLC-deficiency increased posterior tibial translation (PTT) by 1 to 2 mm ($p<0.05$). Both reconstructions reduced PTT to values significantly lower than the intact knee by 1-2 mm, except BT at 30° ($p<0.05$). Forces in the BT graft were higher than those in the intact PLC at full extension and 90° ($p<0.05$) while those in the PFL graft were different from intact only at full extension ($p>0.05$).

CONCLUSION: In this study, neither reconstruction fully restored knee kinematics or in situ forces to the intact level. As hypothesized, PFL better restored ER and in situ forces in the PLC. This may reflect the nonanatomic nature of the BT. However, both techniques over-constrained the knee under posterior tibial loads. Clinically, this may have implications for range of motion or failure of the graft over time.

28. MEASUREMENT OF FORCES ON THE POSTEROLATERAL STRUCTURES OF THE KNEE. *Robert F. LaPrade, MD;* ***Fred A. Wentorf, MS****; Andy P. Tso, BS; Jack L. Lewis, PhD*

Objective: The function of the posterolateral structures (PLS) of the knee joint have been studied using sectioning studies in cadaver joints. However, the loads carried by these structures during loading of the joint have not been reported. The purpose of this study was to measure the loads in the PLS of cadaveric joints for a variety of external applied loads.

Methods: Forces were measured in the fibular collateral ligament (FCL), the popliteofibular ligament (PFL), and the popliteus tendon (PLT) in 10 fresh frozen cadaver knees using buckle transducers. Testing involved placing the knee in a loading apparatus where a buckle transducer was attached to the appropriate ligament, and testing was carried out at 0°, 30°, 60°, and 90° of knee flexion with internal rotation, external rotation, varus, valgus, anterior drawer, and posterior drawer loads individually applied across the knee joint. Load responses per applied load or moment were then calculated from the buckle transducer outputs.

Results: The FCL was found to be loaded during several different load applications (Table 1). Varus loading created a mean force of 12 N/J (load per applied moment) through all flexion angles. Ex-

ternal rotation caused the highest force on the FCL per applied moment, 18 N/J, and significantly decreased with flexion angle. Application of an internal rotation torque loaded the FCL slightly, 2 N/J for all flexion angles. Anterior and posterior forces, and valgus moment did not load the FCL. The PFL and PLT were found to have similar loading patterns. External rotation torque was the only applied load that created force in the PFL and PLT for the applied loads. Application of an external rotation torque at zero degrees created a force in PLT of 3.8 N/J and the PFL of 3.8 N/J, which increased with flexion angle.

Conclusions: This study quantifies the loads seen by the PFL, FCL, and PLT during application of external loads to the knee. During external rotation, the FCL saw high loads early in flexion and the PFL and PLT were loaded more in later flexion. Varus loading only created a force in the FCL and no other structure. These results will give a measure of the potential for failure of these structures during joint loading, and guide graft strength requirements for reconstruction.

TABLE 1

	0° flexion	30° flexion	60°flexion	90° flexion
FCL - varus12 + 3.9 N/J	14 + 3.6 N/J	12 + 3.2 N/J	10 + 2.6 N/J	
FCL - int. rot.	1.7 + 1.3 N/J	3.3 + 2.2 N/J	3.0 + 3.1 N/J	3.6 + 2.6 N/J
FCL - ext. rot.	18 + 6.7 N/J	18 + 9.1 N/J	9.3 + 7.6 N/J	1.6 + 1.8 N/J
PFL - ext. rot.	3.8 + 1.7 N/J	9.2 + 6.2 N/J	14 + 9.8 N/J	12 + 8.7 N/J
PLT - ext. rot.	3.8 + 4.5 N/J	8.9 + 6.8 N/J	14 + 9.2 N/J	13 + 7.3 N/J

29. THE CAUSE OF POSTEROLATERAL ROTATORY AND VARUS INSTABILITY OF THE KNEE – A BIOMECHANICAL STUDY.

***Yasunori Suda, MD, M.Phil.**; Hideo Matsumoto, MD, PhD; Toshiro Otani, MD; Kyosuke Fujikawa, MD, MPhil*

PURPOSE: To investigate the cause of posterolateral rotatory instability (PLRI) and varus instability of the knee experimentally using 12 knee specimens.

METHODS: In each specimen, the degree of external tibial rotation and the magnitude of posterior tibial translation were measured under an 8 Nm external rotational torque together with a 147 N posterior force, at flexion angles of 0°, 30° and 90°. The degree of varus rotation, under a 12 Nm varus torque, was also measured. Each measurement was performed, first with all ligaments intact, then after sequential sectioning of the LCL, posterolateral complex (PLC; including popliteus-complex, arcuate ligament, fabellofibular ligament and posterolateral capsule) and PCL in different orders.

RESULTS: When the LCL and PCL were sectioned but the PCL was preserved, significant increases in both external rotation (11.8 - 21.3°) and posterior translation (4.0 - 9.1 mm), namely PLRI, were observed at all flexion angles. A significant increase in varus rotation (varus instability) was also recorded (4.8 - 8.9°). These instabilities became more obvious when the PCL was sectioned additionally. However, so long as one of the LCL and PLC remained intact, significant PLRI and varus instability did not occur, even when the PCL was sectioned (increase in external rotation $<5.5°$, that in varus rotation $<5.3°$).

CONCLUSIONS: These data indicate that significant PLRI and varus instability occur only when both the LCL and PLC are injured. The PCL injury aggravates these instabilities but is not an essential factor for their occurrence.

SIGNIFICANCE: The present data will be useful for clinically diagnosing PLRI and varus instability.

30. A NOVEL POSTEROLATERAL KNEE RECONSTRUCTION: AN IN VITRO BIOMECHANICAL STUDY.

*Robert F. LaPrade, MD; **Steinar Johansen, MD**; Lars Engebretsen, MD, PhD; Fred A. Wentorf, MS*

Objective: To date, no surgical method for posterolateral knee instability anatomically reconstructs the three major stabilizing structures of the posterolateral knee: the fibular collateral ligament (FCL), the popliteus tendon (PLT), and the popliteofibular ligament (PFL). In this study, a novel technique which reconstructs the anatomy of these structures was demonstrated and tested *in vitro*. The primary hypothesis was that static varus and external rotatory stability will be restored to the reconstructed knee. A secondary hypothesis was that the relative loading forces will be restored in the reconstructed ligaments.

Methods: The anatomic locations of the original FCL, PLT, and PFL were replicated using a two graft technique. Ten paired cadaveric specimens were tested by applying loads in varus and external rotation three times at 0°, 30°, 60°, and 90° of flexion. Each specimen was tested in three states: intact knee; knee with the FCL, PLT, and PFL cut to simulate a grade III injury; and reconstructed knee. The primary hypothesis was tested using motion analysis data. The secondary hypothesis was tested using force data obtained from buckle transducers placed on the FCL and the PFL in the intact knee, and on the FCL and PLT grafts in the reconstructed knee.

Results: For the varus loading tests, a significant increase in translation occurred between the intact knee and the cut posterolateral structures knee ($p<.01$). Joint instability was restored by the posterolateral reconstruction ($p<.02$), which was not different from the nature knee stability.

The load response of a given ligament was obtained from the buckle transducer data at each flexion angle2. The average varus load response of the intact FCL was significantly higher than that of the intact PFL ($p<0.01$) and the reconstructed FCL ($p<0.05$) at 30° , 60°, and 90°. There was, however, no significant difference at any flexion angle between the average varus load responses of the reconstructed FCL and the reconstructed PLT (Table 1).

Conclusions: This work demonstrated and tested a novel two graft reconstruction of the primary static stabilizers of the posterolateral knee: the FCL, PLT, and PFL. This technique restored static varus stability, as measured by joint translation in response to varus loading, to knees with grade III posterolateral injuries at most flexion angles. This procedure also significantly reduced the FCL varus load-bearing capacity in the reconstructed knee, to the point where it is indistinguishable from the varus load-bearing capacity of the reconstructed PLT.

TABLE 1: *Mean varus load response (N/N-m)*

	0°	30°	60°	90°	
Intact FCL	15 ± 6.6	17 ± 7.1	16 ± 6.3	11 ± 5.7	
Intact PFL	.31 ± .28		.41 ± .66	.99 ± 1.4	2.3 ± 2.9
Recon. FCL	4.9 ± 4.3		9.1 ± 2.4	8.2 ± 2.1	4.1 ± 2.4
Recon. PLT	2.6 ± 3.6		5.8 ± 5.3	9.0 ± 6.5	13 ± 15

31. A CLINICAL COMPARISON OF SURGICAL RECONSTRUCTION FOR OSTEROLATERAL ROTATIONAL INSTABILITY OF THE KNEE.

***Fernando Radice**; Vicente Gutierrez; Christian Haberle; Roberto Yañez; Fernando Gonzalez*

Purpose: The goal of this study was to compare three reconstruction techniques: direct anatomic repair, biceps femoris tenodesis and the Clancy posterolateral reconstruction based on tibial and fibular collateral ligament (two limbed reconstruction).

Method: We evaluated the results of 19 patients with multiple ligament injured knees, two of them bilateral, between March 1994 and

June 2000. There were 21 knees with combined injuries: 5 cases with ACL/PL instability; 7 cases PCL/PL instability and 10 cases involved ACL, PCL and PL. The patients were divided into three treatment groups: Group A (12 knees) treated with primary direct anatomic repair; Group B (9 knees) treated with biceps femoris tenodesis and Group C (5 knees) treated with Clancy posterolateral reconstruction with two bundles. For the Clancy posterolateral reconstruction with two bundles, we used a quadricipital tendon graft. Follow-up included chart review, clinical exam, isokinetic and functional hop test. Assessment was carried out using the International Knee Documentation Committee (lKDC) evaluation form. We compared the groups using Student's paired t-test.

Results: Group A: 8 of 12 (66%) related restrictions regarding activities of daily living and were not satisfied with the surgical procedure. The IKDC knee rating scores remained in the poor category and 5 patients required an additional reconstructive surgery. Isokinetic testing revealed peak torques of $>$ 85% in 10 patients. Group B: 7 of 9 (77%) related no restrictions regarding activities of daily living and return to work. 8 patients (89%) were satisfied with their results. The isokinetic test revealed peak torques of $>$ 85% in 7 of 9 patients. Group C: All patients (100%) returned to their original work without restriction for daily activities. Two (40%) returned to sports activities without restrictions. No reverse pivot shift was observed. One patient had residual posterior laxity. We found statistically significant difference between the group A and the groups B and C ($p:\leq 0.05$). No statistical difference was observed between group B and C.

Conclusion: We have found the biceps tenodesis and the Clancy posterolateral reconstruction to be clinically successful in restoring stability and function of the knee with posterolateral instability. We believe that the Clancy reconstruction surgery is a excellent technique for the multiple ligament injured knee. The direct acute anatomic repair without a useful augmentation is less successful and usually will require a second procedure.

32. 34 KNEE DISLOCATIONS IN 3 YEARS; A COMPARISON OF OPERATIVE TECHNIQUES. *Andrew S. Levy, MD*

Purpose: To determine whether delaying the ACL reconstruction in knee dislocations results in decreased morbidity. To compare delayed ACL/PCL reconstruction with acute repair/reconstruction.

Methods: 34 Knee dislocations were treated by a single author in a 3 year period. The first 13 (Group A) were treated by acute ($<$2wk) full open repair/reconstruction. The next 9 (Group B) by acute repair/reconstruction of PCL and collateral ligaments with ACL reconstruction performed at 6-12 weeks. The final 12 (Group C) were treated with acute Posterolateral repair followed by delayed ACL/PCL reconstruction at 6-8 weeks. Avg. follow-up was 31 months (24-49).

Results: Peroneal nerve injuries occurred in 11 cases. One complete avulsion was treated by nerve grafting. Complete recovery occurred in 6, partial in 2 and none in 3 cases. The posterolateral comer was disrupted in 22 cases and was anatomically repaired in all. One patient subsequently required reconstruction (Group B). The lateral meniscus was torn in 14 cases (12 repaired) and the medial in 16 cases (10 repaired). There were no clinical failures of repair noted. Five chondral lesions were treated by microfracture.

The ACL was repaired (bony avulsion) in 2 cases, reconstructed with allograft in 13 cases and autograft in 16 cases. The PCL was repaired to bone in 17 cases and reconstructed in 10 cases (10 allograft). There were 2 popliteal artery disruptions requiring repair. At final follow-up, max manual KT-1000 results were $<$3mm side to side in 92% of cases. Grade I posterior drawer was noted in 78% of cases, with 22% negative. There was no correlation between repair vs reconstruction in posterior drawer.

Complications included 1 wound infection (Group B), 1 wound dehiscence (Group B), and one Amputation (Group B). Heterotopic ossification requiring excision occurred in 2 cases (1 each Group A & B). Contractures requiring debridement and manipulation occurred in 9 cases (4 Group A, 4 Group B and 1 Group C). Final Flexion averaged 135 degrees in Group C, 122 degrees in group A and 115 degrees in group B. Neither cruciate graft selection nor PCL repair vs. rec correlated with HO or contracture.

Return to recreational sporting activities was noted in 7 patients in group A, 5 patients in group B and 10 patients in group C. One athlete returned to collegiate football. Return to sporting activities and overall knee scores correlated with pre-injury functional level, arthroscopic ACL/PCL and absence of biceps avulsion. Chronic pain was reported in 3 patients and was controlled with NSAIDs.

Conclusions: The present study demonstrated no advantage in terms of morbidity prevention of delaying just the ACL reconstruction in knee dislocations. Acute posterolateral repair combined with delayed ACL/PCL reconstruction resulted in the best clinical results and can be recommended.

33. SPORTS-RELATED HAMSTRING STRAINS IN SPRINTERS AND DANCERS – DIFFERENT AETIOLOGIES AND INJURY SITES. *Carl Askling; Magnus Tengvar; Tönu Saartok; Alf Thorstensson*

OBJECTIVE: Hamstring strains are common injuries in sports. The main purpose of this study was to determine if there is a link between the aetiology and the specific location and character of the injury.

METHODS: So far, 9 females athletes, 5 sprinters and 4 dancers, (mean age 23 y, range 20-28 y), with clinically diagnosed acute, first-time, hamstring strains, have been investigated at four occasions ($<$4, 10, 21 and 42 days) after the injury. The results presented here are mainly from the first examination. MRI was used to determine the exact location of the injury. Clinical examination included measurement of range of motion (ROM) with the straight leg raise (SLR) test, isometric knee flexor strength and palpation of the area of maximal tenderness. A specific dynamic hamstring ROM-test was performed at 6 weeks after the acute injury. Using a visual analogue scale (VAS, 1-10) the patients estimated pain, stiffness and sense of insecurity, when performing repetitive voluntary SLRs at a set pace. All values for the injured leg were expressed in percent of those for the uninjured leg.

RESULTS: MRI showed that all 5 sprinters had injuries in at the long head of the biceps femoris muscle, one in the proximal half, two in the distal half of the muscle belly, and two both in the muscle and tendon tissue at the proximal muscle-tendon junction. In contrast, the four dancers all had their injuries in the proximal tendon of the semimembranosus muscle. There was good overall agreement between the area of maximal tenderness located by palpation and the injury site determined by MRI. Mean isometric strength of the injured leg was 49% (range 35-59%) in the sprinters and 69% (range 41-94%) in the dancers. The SLR test showed that the ROM of the injured leg was 84% for the sprinters and 83% for the dancers. In the specific hamstring-test at 6 w, the ROM values for the injured leg were 87% (sprinters) and 86% (dancers). In the same test, the sense of insecurity for the injured leg was rated 3.6 (2.0-6.0) in the sprinters and 4.5 (2.0-7.0) in the dancers; all ratings of insecurity of the uninjured leg were 0. The actual time until return to pre-injury level of performance (5-24 w for sprinters, 12-48 w for dancers) was considerably longer than subjectivity estimated (1-8 w for sprinters, $<$2 w for dancers).

CONCLUSIONS: The aetiologies of the injuries were entirely different in the sprinters compared to the dancers. The injury of the

sprinters occurred during high-speed, explosive sprinting, whereas the dancers were injured during slow-speed, stretching type of exercise. Interestingly, there seems to be a coupling between aetiology and location of the injury, since the hamstring strains in sprinters occurred preferably in muscle tissue, i.e., in the long head of the biceps femoris muscle, and in dancers mainly in tendon tissue, i.e., in the proximal tendon of the semimembranous muscle. Thus, a "muscle strain" can, in fact, turn out to be a partial tendon rupture. All athletes severely overestimated their ability to return to their sport after injury. This may lead to premature return to training and sports without proper rehabilitation, which, in turn, may increase the risk of recurrence and chronicity of these injuries.

SIGNIFICANCE: The demonstrated complexity of the common hamstring strain injury should be considered when prescribing treatment and rehabilitation as well as estimating recovery time.

34. OUTCOMES FOR DECOMPRESSION OF COMMON PERONEAL NEUROPATHY. *Henry Goitz, MD; Mark Bewley, MD*

Common peroneal neuropathy is associated with significant functional deficits including foot drop, numbness, and pain. The outcomes of operative intervention comparing neuropathies from traumatic versus atraumatic etiologies have not been well studied and are needed to determine the potential benefit.

A 6-year (1994-1999) retrospective review of a single surgeon's results of operative decompression for common peroneal neuropathy in 9 patients (5M/4F) was performed. Etiologies included knee dislocation (3), ganglion (2), and idiopathic (4). Each patient had an EMG and MRI and/or US preoperatively. Time from onset to surgery ranged from 18 days to 15 years. Average patient age was 42 (range 22 to 58 years). Each patient had complete decompression and epineurolysis of the common peroneal nerve from its origin to its distal divisions. All patients with knee dislocations also had lateral collateral ligament repair performed. One of them also had an ACL reconstruction.

Four patients with idiopathic peroneal neuropathy (2 with foot drop and numbness; 2 with pain/sensation changes only) had complete resolution of symptoms within an average of 6 weeks (range immediately postoperative to 4 months). Two patients with a ganglion compressing the nerve (both with foot drop, numbness, and pain) had complete resolution of foot drop and numbness within 2 months with only mild pain persisting in one. Three patients with knee dislocations (all with foot drop and numbness; 1 with severe pain also) showed no change in the foot drop. The patient with severe pain had resolution of the pain and another had some improvement in sensation.

Common peroneal neuropathy due to atraumatic etiologies appears to consistently respond very favorably to operative decompression with resolution of symptoms within an average of 6 weeks. Neuropathy associated with knee dislocation does not improve significantly; however, operative decompression may improve sensation or pain symptoms.

35. ENDOSCOPIC ASSISTED COMPARTMENT FASCIOTOMY IN CHRONIC COMPARTMENT SYNDROMES. *A. Goesele; B. Segesser; G. Farkas; P. Jenoure; X. Kaelin*

Introduction: Chronic Compartment Syndromes of the lower leg are a frequent differential diagnosis in sports. The diagnosis of a chronic compartment syndrome is based on a clinical examination and confirmed by a functional compartment pressure measurement. If conservative therapy fails, fasciotomy of the compartment is indicated. The aim of any surgery is to minimize trauma of tissue and to make sure the rate of complications and relapse is small. Due to the fact that conventional surgery techniques were not able to guarantee these goals, our clinic developed a new surgery method in order to fulfill the above mentioned requirements. In addition to this, the new developed technique should guarantee an optimal clinical result.

Materials and Methods: The technique we developed is characterized by a minimal invasive endoscopic assisted operation during spinal or local anaesthesia. A long splayable speculum with a guiding device for a rigid endoscope is penetrated through a 3 cm skin incision above the compartment. Assisted by the endoscope the muscle fascia can be seen very clearly. Under sight an incision of the fascia will be performed and then split by a special modified instrument based on "smilie-knife." The endoscopic controlled fasciotomy will then be completed proximally and distally to the primary incision. Due to the fact of increased compartment pressure the fascia will divide apart. Vessels and nerves can be identified and treated with care. This minimally invasive operation can be done outpatient and if necessary even two or more compartment fasciotomies can be done at the same session.

Conclusions: The minimal invasive endoscopic assisted fasciotomy represents a contemporary modern therapy. It is characterized by a minimized trauma of the involved tissue and a small rate of complication. In addition to this, the clinical results are excellent.

36. FASCIOTOMY OF THE LOWER LEG PAINS IN ATHLETES. *Jussi Rautanen, MD, PhD; Sakari Orava, MD, PhD; Ilmo Helttula, MD*

Purpose: To evaluate: which kind of lower leg pains required fasciotomy, what sport the athletes represented, what was the result after fasciotomy, how often reoperation was needed.

Method: A retrospective clinical series of 588 consecutive lower leg fasciotomies done to 296 patients during years 1985 - 1998.

Results: The were 174 males and 122 females in the series. The mean age of them was 27 years (14-73 years). The mean age in men was 31 years and in women 22 years. All the patients were active in sports. They represented endurance running in 59%, sprinting and hurdling in 18% and orienteering in 10%. There was a minor number of athletes representing ball sports events (4%), power sports (4%) and other track and field sports as running (3%). Two percent of the athletes represented other sports events. The diagnoses were: chronic medial tibial syndrome (195 pts), anterior tibial syndrome (84 pts), posterior calf muscle compartment syndrome (12 pts) and peroneal compartment syndrome (5 pts). Reoperation was needed in 39 cases. Complications were seen in 41 fasciotomies. Only one third of these affected to the final result. End result was good or excellent in 71%, moderate in 24% and poor in 5% of the cases.

Conclusions: Fasciotomy is often the final treatment of chronic lower pain problems. The diagnosis has to be made exactly and the technique of fasciotomy as well as the postoperative care, rehabilitation and prevention of future problems must be known well. In spite of the right diagnosis and treatment all athletes do not have good results.

37. INTERPRETATION AND IMPORTANCE OF PRESSURE MEASUREMENT IN CHRONIC COMPARTMENT SYNDROMES OF ATHLETES. *A. Goesele; G. Farkas; B. Segesser; P. Jenoure; X. Kaelin*

Introduction: Chronic Compartment Syndromes of the lower leg are very frequently overseen in the differential diagnostic process of athlete's lower leg pain. A typical anamnesis shows pain distributed over the entire compartment during and a certain time period after the athlete's activity. In addition to this, a functional pressure measurement

of the compartment should be performed in order to get an objective clinical primary diagnosis. A clinical examination combined with pathological pressure values only allows the diagnosis of a chronic compartment syndrome which then leads to a cause oriented therapy.

Materials and Methods: Between July 1996 and January 2000 our clinic performed 180 pressure measurements of the lower leg compartments based on the possibility of a chronic compartment syndrome. All measurements were performed with a mobile digital device including a piezo electric pressure sensor. After local anaesthesis and disinfection of the skin the pressure sensor – guided by a thin hollow needle – was penetrated into the compartment. After measuring the reference pressure the athlete was loaded according to his sports-specific activity on the treadmill, the bike ergometer or isokinetically up to the incidence of pain. After the athlete had stopped his activity, it was essential to measure the compartment pressure continuously within the following 30 min. at least.

Results: In contrast to the literature where the diagnosis of a pathologically increased pressure is based on absolute pressures, we suggest – based on the retrospective analysis of all our measurements – to use the relative pressure rate between reference pressure before loading and pressure after loading. The final verification of the diagnosis happened during the following surgery (endoscopic assisted compartment fasciotomy). In 98% of the cases with pathologic values the pressure rate was still higher than 15 mmHg (30 min. after loading). The absolute pressures with increased reference pressure above 15 mmHg before loading and above 25 mmHg after loading, however, were only in 85% of the cases pathologic.

Conclusion: The diagnosis of a chronic compartment syndrome is based on a clinical examination and confirmed by a functional compartment pressure measurement. The interpretation of the measurement results needs to be based on the relative pressure rate between reference pressure before loading and pressure after loading in order to make correct judgments about pathologic or normal pressure increase. The analysis of the absolute pressures only is helpful, too, but much less significant than the rate of pressure. The rate of pressure is higher than 15 mmHg in case of a chronic compartment syndrome.

38. ILIOTIBIAL BAND FRICTION SYNDROME: ULTRASOUND AS A DIAGNOSTIC TOOL.

***Koen Peers, MD**; Peter Brys, MD; John Bellemans, MD, PhD; Roeland Lysens, MD, PhD*

PURPOSE: To investigate the use of ultrasound as a diagnostic tool in the evaluation of the iliotibial band friction syndrome (ITBFS).

METHOD: Ultrasound measurements of the iliotibial band were performed on 109 asymptomatic students in physical education and on 59 athletes unilaterally afflicted with ITBFS. The width of the left and right iliotibial band (ITB) and the difference between both were measured. Sensitivity, specificity, positive likelihood ratio and receiver-operating characteristic (ROC) curves were determined to choose the optimal cut-off points.

RESULTS: The mean of the width of the ITB and the mean difference between the width of the ITB of both lower limbs, measured on ultrasound were as follows: 2.8 ± 0.4 mm and 0.0 ± 0.2 mm in the healthy test subjects, 3.6 ± 0.5 mm and 0.6 ± 0.5 mm in the athletes with unilateral ITBFS. ROC curves indicated a width of the ITB > 3.0 mm (sensitivity 86%; specificity 76%; likelihood ratio 3) or a difference in width of the ITB > 0.2 mm (sensitivity 81%; specificity 90%; likelihood ratio 8) between the left and the right ITB, as optimal cut-off points for ITBFS.

CONCLUSION: Ultrasound measurement, using ITB > 3.0 mm or ITB difference > 0.2 mm as criteria, can be used as a diagnostic tool to confirm the clinical findings in iliotibial band friction syndrome.

SIGNIFICANCE: In case of clinical doubt for ITBFS, ultrasound is a more readily available examination with less costs than Magnetic Resonance Imaging, to confirm the diagnosis with objective criteria.

39. THE RISK OF INJURY WHEN PLAYING IN A NATIONAL SOCCER TEAM.

Jan Ekstrand, MD, PhD

PURPOSE: To investigate the injury rates in soccer at national team level and to evaluate if there are any differences between the risk of injury in a match won and a match lost or between home and away matches or matches on neutral ground.

METHOD: The senior male national team of Sweden was followed in 60 matches during 1991-1997. The period included 7 World Cup matches (USA, 1994), 4 European Cup matches, 20 matches for qualification to the World Cup or the European Cup, 26 friendly matches and 3 training-camps. Attendance records were kept for all training sessions and matches. The time of exposure was registered for each individual player and the incidence of injury was based on the real exposure time. All injuries were registered. An injury was defined as any injury occurring during matches and training sessions and causing the player to miss the next match or training session (in the national team or in his ordinary team).

RESULTS: The total exposure was 7,210 hours. The exposures to matches and training sessions were 1,010 and 6,200 hours respectively. A total of 60 injuries occurred, 30 of them occurred at training and 30 at matches. The majority of injuries were minor with less than 1 week's absence from training but 5 (16%) of the match injuries caused absence from football more than a month. The risk of injury at training was 6.5/1000 training hours. The risk of injury was increased during training camps compared with regular training (16.5 versus 6.5 injuries/1000 H, $p < 0.05$). The risk of injury during match was 30/1000 match hours and greater at important matches. It was also noted that the risk of injury was higher during matches lost (56 injuries/1000 hours played) than matches won or matches ending in a draw (22 injuries/1000 hours played). No difference in the risk of injury was noted between home and away matches or matches on neutral ground.

CONCLUSION AND SIGNIFICANCE: The risk of injury during training with the national team is approximately the same as during training with club teams regardless of the level of play. The risk of injury increases during training camps compared with regular training. The risk of injury during a match is greater than during training. The risk of injury increased with the importance of the match. The risk of injury was greater during matches lost. Possible explanations for this finding will be discussed.

40. PREVENTION OF ACL INJURIES IN FEMALE _SOCCER PLAYERS – A PROSPECTIVE STUDY.

***Johan Leanderson, MD, PhD**; Pia Sundhage, Athl.Tr.*

Previous studies have suggested that ACL-injuries are more common in females than in males. The purpose of this study was to investigate if a training program with technique and coordination exercises could prevent ACL-injuries in female soccer players.

Material and Method: 18 female second division soccer teams in Sweden (27 team seasons) have participated in the study. The mean age was 20 years. Nine of the teams were subjected to a preseason test before the study, which included a clinical examination, anatomical measures and recording of previous injuries. Included in the regular team practice, a training program was included which included two parts;

1 ankle disc training,

2 "the eight minutes program," three exercises specially focused on technique and coordination.

Results: Of 146 players in nine teams included in the preseason test, 21 players (15%) had a previous ACL-reconstruction performed. No difference in knee width, leg length or knee width/leg length ratio was registered. During the season preceding the study, 14 ACL-injuries in 18 teams were registered, 0.78 inj/team season. After the inclusion of the training program, five ACL-injuries during 27 team seasons were registered, 0.19 inj/team season.

Conclusion: No difference in anatomical measures could be noted between players with and without an ACL-injury. The results of the present study supports a previous study suggesting that ACL injuries can be prevented with coordination training.

41. ACUTE TAEKWONDO INJURIES. ***Metin Lüfti Baydar, MD****; Nevres H. Aydogan, MD; Kadir Yagiz, Instructor; Cengiz Yagiz, President*

Introduction: It is one of those moments of symmetry, so often unplanned. When taekwondo is introduced into the Sydney 2000 Games as one of two new Olympic sports, the games ending the second millennium will be introducing a sport that is 2000 years old. Murals in the ruins of royal Korean tombs some 2000 years old show men practicing a form of unarmed combat. The martial arts tradition persisted over the centuries, enjoying a glory day 800 years ago when a self-defense art called subak emerged with a strong following. Evidence even suggests it was practiced as a sport in the truest sense, to entertain spectators. Korea still dominates the sport, but European and other Asian countries have begun to challenge. At the last World Championship, Korea's men beat out Iran and Turkey.

Material & Methods: In this study, we evaluated 20 national team players according to acute injuries in international competitions at last two years. 11 players were men, 9 players were women. Average age was 21. We recorded all injuries and treatment modalities.

Results: We saw a contusion of dorsal foot in 80% of players after every contest. We treated with ice pack and taping. 2 players had mandible and colles fractures In training. 0ther injuries that we saw were ankle sprain, partial rupture of adductor femoris tendon, acute shoulder dislocation, menisci lesions, ACL and PCL lesions. Mandible fracture that treated with open reduction and internal fixation. Colles fracture that treated with closed reduction and cast immobilisation at 6 weeks. We performed arthroscopy for 1 of 3 ankle sprains, others that applied cast immobilisation at 3 weeks. Partial lesions of adductor femoris tendon that treated with conservative and physicotherapy. We performed arthroscopic treatment for acute shoulder dislocation, ACL and PCL lesions.

Conclusions: For prevention of acute injuries in taekwondo competitions, protection materials of pretibial, forearm, head, groin and chest are very important. After this evaluation, on behalf of medical committee of Turkish Taekwondo Federation, we offered that taping of dorsal foot is mandatory for every contest to World Taekwondo Federation.

42. THE BENEFICIAL EFFECT OF ONE-YEAR TAI-CHI (SHADOW BOXING) IN RETARDATION OF BONE LOSS IN POSTMENOPAUSAL WOMEN. *Kai Ming Chan; Edith M.C. Lau; Jean Woo; Simon K.M. Lee; Ling Qin;* ***Henry C.L. Ho***

PURPOSE: To explore the beneficial effect of Tai Chi in postmenopausal women in terms of bone loss, muscle strength and body flexibility.

METHOD: 84 postmenopausal women, without history or medication affecting bone metabolism and no regular physical exercise, were recruited. They were randomized into Tai-Chi (TC; n=43) and normal control (NC; n=41) groups. TC subjects practiced Tai-Chi on average 3.75 hours/week under supervision for 12 months while NC subjects remain inactive. Measurements included: 1) volumetric BMD and bone strength index (BSI) of non-dominant distal tibia and radius by peripheral QCT (Densiscan 2000); 2) Areal BMD of AP spine and proximal femur by DXA (Norland XR-36); 3) bend reach ability and 4) quadriceps strength. All measurements were repeated 12 months later. SPSS 9.0 was used for statistical analysis, with significant level set as $p<0.05$.

RESULTS: pQCT data showed a significant higher bone loss rate and decrease in BSI ($p<0.05$) in distal tibia of NC compared with TC (Table 1). Paired t-test showed a significant increased quadriceps muscle strength and improved bend reach ability ($p<0.05$) in TC group but not in NC group after 1 year exercise.

TABLE 1: ANNUAL PERCENTAGE CHANGE OF vBMD AND BSI

Annual percentage change (%)	TC	NC
Distal Tibia trabecular BMD	-0.56±1.50	-1.68±1.45
Distal Tibia integral BMD	-0.89±1.74	-1.90±1.56
Distal Tibia cortical BMD	-0.55±1.32	-1.68±1.45
Proximal Radius cortical BSI	-0.61±3.12	-1.99±2.75
Proximal Tibia cortical BSI	-0.83±2.11	-1.88±1.57

CONCLUSION & SIGNIFICANCE: Our data indicated that 12 months TC exercise results in deceleration of bone loss and BSI in the weight bearing skeletons. Tai-Chi also improves muscle strength and body flexibility, which may help to off set the aging and skeletal-muscular problems related to decrease physical exercise. With comparison of other exercise program such as brisk walking in our other study, TC exerciser shows a much lower drop out rate (23% in TC vs. 49% in brisk walking program).

43. OSGOOD SCHLATTER'S DISEASE IN YOUNG MALE BASKETBALL PLAYERS. ***Aleksandar Jakovljevic****; Nikola Bojic; Aleksandar Gajic; Branislava Jakovljevic*

In this work we present our experiences with Osgood Schlatter's disease in young basketball players. In the period from June 30th, 1996, to January 1st, 2000, nine young basketball players were treated. From one overall number of 257 young basketball men players with ages 10-16, nine or 3.5% of them were inflicted by disease.

The youngest had 11 years and 3 months and the oldest had 14 years and 6 months. In two young players who suffered from a disease, it was mutually. Diagnosis was made by clinical findings of swelling and pain in area of tibial tubercle and X-rays.

We used Watson Jones classification of Osgood Schlatter's disease. Two patients from group 1A were treated by resting for 3 months, physical rehabilitation for one month and for two months resting in addition. 3 other patients from group 1A, and 3 from group 2A were treated by plastic cast immobilization with extended knee in duration of 6 weeks, and 3 months resting and one month of physical rehabilitation. After 6 months everybody is allowed full training. X-ray controls were done after 3, 6 months and one year.

Results: All 9 patients, after treatment were able to full motions in their knees.

Conclusion: Stronger physical activity in an early adolescence is one of main factors of appearing Osgood Schlatter's disease. Treatment that includes temporary stopping of physical activities combined with plastic cast immobilization – according to indications – provides complete clinical and radiological convalescence which makes possible the great comeback to the full sports activities.

44. EVALUATING ANTERO-MEDIAL INSTABILITY: A NEW METHOD OF PHYSICAL EXAMINATION. ***Gideon Mann, MD****; Joseph Lowe, MD; Naama Constantini, MD; S. Shabat, MD; A. Finsterbush, MD; G. Chaimsky, MD; U. Frankel; Meir Nyska, MD*

Introduction: The crucial ligaments of the knee control anterior-posterior stability and prevent internal rotation of the tibia on the femur. The collateral ligaments control side to side motion and prevent external rotation of the tibia on the femur. Damage to the ACL when accompanied by injury to the lateral structures will allow the pivot shift phenomena in which the lateral tibial condyle rotates forward over the lateral femoral condyle, while pivoting around the PCL axis or the axis marked by the medial structures and the postero-medial corner. The pivot phenomena is assisted by the convex shape of the lateral tibial plato and by the ITB snapping the lateral tibial condyle into place during flexion.

Damage to the medial collateral ligament and to the postero-medial corner will allow a "Medial Pivot Sign" or an anterior rotatory displacement of the medial tibial condyle over the medial femoral condyle.

As the medial side of the knee is lacking the convexity of the tibial condyle and lacking the posterior displacing force of the ITB the medial pivot can be elicited only actively.

Material and Methods: Since the late 1980s, we have routinely used a specific physical examination to detect antero-medial instability in all knee injuries. In over 15,000 examinations (according to clinic records) the examination has been proven as easy to perform, accurate and specific in diagnosing anteromedial instability and useful in locating a postero-medial tear of the meniscus. A clear snap is produced while the torn meniscus is displaced forward and then back again over the medial femoral condyle. Often the antero-medial instability was the sole pathology located in a symptomatic and troublesome knee.

Technique of Examination: The examining physician sits on the edge of the bed, his foot nearer the head of the bed placed on a step and his knee at the level of the examined knee. The patient's knee is held in abduction and external rotation and laid on the physician's knee, slightly flexed. One hand holds the foot and the other hand holds the knee with the thumb on the proximal tibia assisting the other hand in active external rotation and active forward displacement of the medial tibial condyle over the medial femoral condyle. The index finger is held on the joint line thus providing semi-quantitative evaluation of the amount of antero-medial displacement. An additional snap felt while performing the examination would usually disclose a postero-medial meniscal tear, mostly a short bucket handle type.

Conclusions: We have described a physical examination for antero-medial instability of the knee, which has been routinely used for over 10 years. In our hands the examination has proven valuable in diagnosis of the antero-medial knee instability, easy to perform, accurate and specific. A postero-medial meniscal tear often elicits a clear snap during the tibial condyle displacement. The so called "Medial Pivot" phenomena must be actively performed as the concave medial tibial condyle and the absence of the posterior pull of the ITB will exclude passive occurrence of the displacement and relocation as is apparent in the classic lateral pivot shift test.

45. BIOMECHANICAL PROPERTIES OF CRUCIATE LIGAMENT CONSTRUCTS USING WITH HAMSTRING TENDONS. ***Yuji Uchio, MD,*** *PhD; Mitsuo Ochi, MD, PhD; Kenzo Kawasaki, MD; Junji Iwasa, MD*

PURPOSE: To determine the biomechanical properties of Shimane Leeds Loop ligament (SLLL) and number 5 Ethibond loops and EndoButton tape in cruciate ligament constructs.

METHODS: Twelve constructs consisting of an EndoButton, an SLLL, bovine tendons sutured with a Leeds-Keio dense tape (LK) were fixed on a wood block using double buckle stapling (Group A). Twelve other constructs made up of an EndoButton, looped five number 5 Ethibond threads / a looped EndoButton tape, and bovine tendons sutured with Ethibond threads were fixed with a screw (Group B / C). The groups were subjected to static test and cyclic loading (50 N to 150 N, 5 Hz, 90000 cycles). The Institutional Review board approved the use of animal subjects for this research. The data were statistically analysed by ANOVA.

RESULTS: *Static test:* The ultimate tensile load in Group A was the highest (A: 795.0 $\pm$ 69.5 N, B: 365.2 $\pm$ 127.5 N, C: 334.5 $\pm$ 67.4 N, $p<0.001$). Group A had the highest stiffness (49.1 $\pm$ 12.4 N/mm), and the B or C construct had significant lower stiffness (10.8 $\pm$ 3.1 N/mm, 10.3 $\pm$ 3.1 N/mm, $p<0.05$).

Cyclic loading: The maximum elongation in Group A (3.7 $\pm$ 1.2 mm) was smaller than that in Group B (14.6 $\pm$ 6.8 mm) or Group C (22.4 $\pm$ 6.5 mm, $p<0.05$).

CONCLUSION AND SIGNIFICANCE: These findings suggested that SLLL-Tendons-LK-staple complex can acquire strong initial strength and avoid an elongation during the early postoperative period. In conclusion, this complex is a safer construct for postoperative rehabilitation.

46. BIOABSORBABLE INTERFERENCE SCREW FIXATION IN A BONE TUNNEL: COMPARISON OF 28 MM, 35 MM SINGLE SCREW FIXATION AND BICORTICAL FIXATION WITH 20 MM AND 17 MM SCREWS. ***Onur Tetik, MD****; Jefferey Selby; David N.M. Caborn*

Introduction: Initial tibial fixation strength is the weak link after ACL reconstruction using a quadrupled hamstring graft with bioabsorbable interference screw fixation because of bone mineral density and direction of load. The purpose of this study was to determine the biomechanical differences between unicortical 28 mm, unicortical 35 mm and bicortical fixation with 20 mm and 17 mm interference screws for tibial fixation of a soft tissue graft.

Material and Method: 18 paired fresh frozen cadaveric knees average age 36.4 (19-45) were randomized into group 1 (28 mm screw), group 2 (35 mm screw) and group 3 (20 mm and 17 mm screws). After harvesting the hamstring tendons, all soft tissues were stripped from the knees and DEXA scan was performed for bone mineral density (BMD). BMD cut off point was 0.6 g/cm and we excluded two pairs from the study because of BMD. Quadrupled hamstring tendons were prepared by our previously described technique were secured with either 28 mm or bicortical screws in the tibial tunnel which was impacted to within 0.5 mm of graft size from 2 mm less than a graft size. In groups 1 and 2, 28 mm and 35 mm screws were placed posteriorly in the tunnel to a level even with the anteromedial cortex. In group 3, 20 mm screw was placed posterior to the graft and 17 mm screw was placed anterior to the graft to a level even with the anteromedial cortex of the tibia. Failure mode, displacement prior to failure, ultimate failure load, and stiffness were tested with an Instron machine in the line with the tibial tunnel to simulate a worst case

scenario. The graft was cycled 10 times from 10 to 50 N before testing to failure at a rate of 20 mm/minute.

Results: For group one (one, 28 mm-screw fixation), the mean maximum load at failure was 0.4881+/-0.1974 KN, displacement at failure was 18.427+/-7.485 mm and stiffness was 38.978+/-7.022 N/mm. For group two (one, 35 mm screw fixation) mean maximum load at failure was 0.84251+/-0.1199 KN, displacement at failure was 14.53+/-1.689 mm and stiffness was 75.505+/-13.42 N/mm. For groups three (double screw fixation) mean maximum load at failure 0.5437+/-0.2665 KN, displacement at failure was 16.059+/- 8.587 mm and stiffness was 57.69+/-14.92 N/mm. The average bone mineral density was 0.847 gr/cm2 (0.689- 1.11 gr/cm2). The statistical analyses were done by ANOVA test. The statistical analysis showed significant difference at load to failure mode between 28 mm vs. 35 mm screws (p: 0.0287) and in stiffness between 28 mm and the other two groups (p: 0.0005 for 28 mm vs. 35 mm, and p: 0.04 for 28 mm vs. bicortical fixation).

Discussion: Quadrupled hamstring ACL reconstruction requires fixation of soft tissue in a bone tunnel. We have shown that 35 mm one screw and bicortical bioabsorbable interference screw fixation increase ultimate stiffness without compromising pullout strength. In addition bicortical fixation and 35 mm screw will diminish joint fluid extravasation into the tunnel and potentially increase a more satisfactory environment for Sharpey fiber formation. Significant variables in hamstring fixation within a bone tunnel include bone mineral density, implication, gap size, screw placement, and size (width and length). Attention to these variables may provide secure graft fixation during biologic incorporation throughout the rehabilitation period.

47. MRI EVALUATION OF CROSS-SECTIONAL AREA OF THE TRANSPLANTED ANTERIOR CRUCIATE LIGAMENT GRAFT. PATELLAR TENDON VS. HAMSTRING TENDON. ***Yasuyuki Ishibashi, MD****; Seiko Harata, MD; Yoshihisa Okamura, MD; Tomoyuki Sasaki, MD*

PURPOSE: The bone-patellar tendon-bone (BTB) and hamstring tendon (STG) have been popular graft materials for the anterior cruciate ligament (ACL) reconstruction. Recently, STG has been used more frequently, because a greater cross-sectional area (CSA) of the graft can be obtained by double or triple looped STG. The purpose of this study was to determine the CSA of the transplanted ACL ligament one year after reconstruction with the two types of graft materials using MRI.

MATERIALS AND METHODS: Seventy-seven cases, which underwent ACL reconstruction using BTB or STG graft, were studied; 49 in the BTB group; and 28 in the STG group. MRI was performed one year after ACL reconstruction, and the CSA of the reconstructed ligament was measured in the oblique axial image. Anterior laxity was also measured using a KT-1000 arthrometer.

RESULTS: Although initial CSA in the STG group was greater than in the BTB group, there was no significant difference one year after reconstruction. Mean CSA of reconstructed ACL was 57.8 $\pm$ 7.8 mm2 in the BTB group, and 58.1 $\pm$ 16.2 mm2 in the STG group. Measurement with the KT-1000 arthrometer showed significantly better stability in the BTB group than in the STG group: 0.9 $\pm$ 0.9 mm, 1.6 $\pm$ 0.4 mm ($P<0.05$).

CONCLUSIONS: Grood reported a significant inverse correlation between the A-P translation and CSA of the graft. In this study, there was no correlation between the CSA of the graft at the time of reconstruction and one year later, as well as between CSA and stability of the knee.

48. DOUBLED SEMITENDINOSUS AND GRACILIS TENDON GRAFTS COMPARED TO DOUBLED SEMITENDINOSUS GRAFTS ALONE IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A PROSPECTIVE RANDOMIZED CLINICAL TRIAL. *Tanya Armour, BSc; Robert Litchfield, MD; Annunziato Amendola, MD; Alexandra Kirkley, MD (a – Bionx);* ***Peter Fowler, MD***

Purpose: To determine if a doubled semitendinosus and gracilis tendon grafts are superior to doubled semitendinosus grafts alone in anterior cruciate ligament (ACL) reconstruction.

Method: One hundred and twenty-two patients with isolated ACL rupture, a side-to-side difference $>$ 3 mm in anterior tibial translation measured by KT-1000™ arthrometer, a stable contralateral knee and closed physes were prospectively randomized to undergo ACL reconstruction with either doubled semitendinosus tendon autograft (Group 1) or doubled semitendinosus and gracilis tendon autograft (Group 2). All patients signed informed consent. All reconstructions were arthroscopically assisted with endobutton femoral fixation and multiple low profile staple belt buckle tibial fixation. Patients, therapist and examiner were blinded to treatment group. Intra-operatively graft diameter, length, tension, meniscal procedures and articular surface status were documented. Follow-up time points were at 6, 12 and 24 months and included assessments of side-to side difference in anterior tibial translation measured by KT-1000™, the Mohtadi Quality of Life Assessment in ACL Deficiency (QOL), International Knee Documentation Committee (IKDC) evaluation, quadriceps and hamstring strength testing on the Cybex dynamometer at 80, 120 and 180°/second), the single leg forward hop test for distance, and time to rehabilitation milestones.

Results: At 1 year, the data available on 102 patients show no significant differences between groups in any of the study parameters at any study time point. Mean side-to-side differences in KT-1000 measurements were 2.3 mm ($\pm$1.0) for Group 1 and 2.4 mm ($\pm$1.0) for Group 2 ($p=.465$). The mean QOL score for Group 1 was 74.4 ($\pm$15.5) and for Group 2 was 76.3 ($p=.506$). Mean distance on the single leg hop test was 87.0 cm ($\pm$9.1) for Group 1 and 88.5 cm ($\pm$8.9) for Group II ($p=.421$). There were no statistically significant differences between groups in time to reach rehabilitation milestones and Cybex strength measurements for both hamstrings and quadriceps at any of the test speeds.

Significance: This intermediate data indicates that there is no benefit to the addition of the gracilis tendon to the semitendinosus tendon autograft in ACL reconstruction.

49. EQUAL VS. MANUAL TENSIONING OF MULTI-STRANDED HAMSTRING GRAFTS FOR ACL RECONSTRUCTION: A BIOMECHANICAL EVALUATION. ***Antonio Oblacruz, MD****; David Lintner, MD; Phil Noble, PhD; Matt Grunkemeyer, BS; Michael Conditt, PhD; Jerry Alexander, BS*

Introduction: Quadrupled hamstring grafts are becoming more popular for ACL reconstruction. Using an idealized mechanical model, Hamner et al demonstrated that equal tensioning of all strands of a hamstring graft results in mechanical properties superior to those of manual tensioning. The purpose of this study was to determine if equal tension applied to the limbs of a graft in a cadaver model of femoral fixation provided mechanical properties superior to those of manually tensioned graft.

Methods: Using eight pairs of human cadaveric femurs and unmatched hamstring tendons, the femoral portion of an ACL reconstruction was performed using a cross pin femoral technique. The grafts were tensioned for one minute, and freeze clamped at a distance representing the intra-articular length of the graft. One of each pair was

tensioned with 5 lbs per strand; the other was manually tensioned. Using an MTS machine, force was applied to reproduce anterior tibial translation using progressive cyclic loading, followed by load to failure. An infrared camera system was used to track 3-dimensional movement of the femur, graft, and cross pin. Results were compared at submaximal forces similar to those of physical therapy and at forces similar to the maximal loads of most methods of tibial fixation, in addition to load to failure.

Results: Tensioning techniques had no significant difference on ultimate load to failure (manual: 1192±132 N, weight: 1106±145 N), or in the dynamic stiffness (manual: 236±23 N/mm, weight: 264±29 N/mm). We found to be statistically significant when measuring load at 5 mm of creep (manual: 668±85 N, weight: 844±121 N).

Discussion: Despite theoretical advantages, when equal tensioning is performed using a more clinical model (bone tunnel, cross pin fixation, and angle of pull), its benefits diminish. Ultimate load to failure and dynamic displacement was not statistically significant between the two groups. However, there was a benefit to equal tensioning when measuring load at 5 mm of creep. We believe that our difference is not as significant as Hamner et al study because of different angle of pull, and the friction created between the graft and the bone tunnel.

50. DOES "OVER-TIGHTENING" AN ANATOMICALLY PLACED ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION GRAFT LEAD TO FAILURE?

***Marc R. Safran, MD**; Debra Schenk, MD; T. Ted Funahashi, MD*

INTRODUCTION: This study compares the effect of ACL graft tightness on clinical outcome and ultimate knee laxity of ACL reconstruction (ACLR).

METHODS: 73 patients had ACLR for isolated, unilateral ACL tear by 1 surgeon. KT-1000 measurements were performed under anesthesia pre-op and post-op and at regular intervals. Patients with a post-op KT-1000 manual maximum side to side (man-max s-s) difference in the OR < 0 (tight group = TG) were compared with those whose difference that was equal to or looser than (≥ 0) the normal knee (not tight group = NTG).

RESULTS: There were no differences pre-op or intra-op between the 2 groups.

	Male/ Female	Follow-Up	Pre-Op KT-1000	Post-Op KT-1000	KT-1000 OR-6wk	KT-1000 6wk-Last	Final KT-1000
Tight (tg)	28 M/9F	39mo (24-63)	6.8 mm (3-17)	-3.0 mm (-1 - -9)	2.7 mm loosen ($p<0.0001$)	4.7 min ($p<0.0001$)	2.1 mm
Not Tight (ntg)	21M/15F	40mo (24-59)	9.1 mm (4-15) ($p>.01$)	1.2 mm (0-4) ($p<.001$)	0.2 mm tighten ($p=0.99$)	0.6 mm ($p=0.84$)	1.2 mm ($p=0.11$)

There was 1 clinical failure (TG) and 5 with KT-1000 man-max s-s difference $>$ 5mm (3=TG, 2=NTG).

DISCUSSION/CONCLUSION: ACLR grafts made tighter than the normal knee loosen more than grafts that are not tighter than the normal knee. Ultimate laxity and failure rates are similar. Thus, ACL graft overtightening does not appear to affect clinical outcome.

51. TRANSFER OF THE BMP-2 GENE IMPROVES THE TENDON-BONE HEALING OF ACL HAMSTRING GRAFTS.

***V. Martinek, MD**; C. Lattermann, MD; A. Usas, MD; S. Abramowitch; F. Fu, MD; J. Huard, MD*

Introduction: The integration of tendon grafts commonly used for ACL replacement still represents a controversial issue with regard to postoperative knee AP laxity and widening of the osseous tunnels. This study investigates the feasibility of adenoviral BMP-2 gene transfer into ACL tendon grafts in order to enhance the tendon-bone interface following ACL reconstruction in rabbits.

Methods: ACL reconstruction with autologous double-bundle graft and rigid button fixation was performed in 34 adult NZW rabbits. Twenty-four hours prior to implantation, semitendinosus tendons were harvested and infected ex vivo with adenovirus BMP-2 or remained uninfected as controls. Two animals from each group served for histological assessment at 2, 4, 6, and 8 weeks. The remaining nine animals from each group were tensile tested eight weeks following surgery. Ultimate load to failure (N) and stiffness (N/mm) were measured.

Results: In the control group, cellular fibrous scar tissue at the tendon-bone interface showed progressive reorganization, vascularization, and establishment of Sharpey's like fibres over the course of the 8-week observations. In the specimens with infected ACL grafts, a prominent osteoblastic activity, chondrification and neo-ossification at the tendon-bone interface was visible as early as two weeks following surgery, seeming to integrate the ACL grafts with the osseous tunnels. The tensile properties of the specimen confirmed this histological impression. The ultimate load to failure 108.8±50.8 N vs. 45.0±18.0 N and the stiffness 29.0±7.1 N/mm vs. 16.7±8.3 n/mm were significantly enhanced for the specimens with transduced ACL grafts.

Conclusions: Adenoviral BMP-2 gene transfer significantly improves the integration of ACL tendon grafts in the tunnel. For the first time, the potential of gene transfer was demonstrated to improve healing following ACL reconstruction. However, before gene transfer techniques can be established for clinical usage, further research is needed to answer many open questions regarding the safety and regulation of this procedure.

52. A STRESS-RADIOGRAPHIC STUDY ON THE MEASUREMENT OF ANTERIOR AND POSTERIOR DRAWER IN 563 NORMAL KNEES AND IN 487 ACL DEFICIENT KNEES. LAXITY CLASSIFICATION.

***J.L. Lerat**; F. Cladiere; B. Moyen; J.L. Besse*

PURPOSE: The aim of this prospective study was to measure anterior and posterior play in normal knees and in chronic ACL deficient knees, in order to grade knee play and classify laxity so as to choose adapted reconstructive surgery.

METHOD: 563 normal knees and 487 ACL deficient knees were studied (mean age: 27.7 ± 9 y). Stress-radiography was performed using a simple apparatus maintaining the knee at 20° flexion and with a 9 kg load applied at the distal part of the thigh. Using a radiological zero position defined by the tangent to the condyles parallel to the posterior tibial cortex, medial and lateral compartment laxities were measured.

RESULTS: For normal knees, the mean Anterior Translation for the Medial Compartment (ATMC) was 2 ± 2.7 mm and for the lateral compartment (ATLC): 10.4 ± 3.7 mm. For ACL deficient knees, the laxity was respectively: 10.5 ± 4.3 mm and 18.5 ± 5 mm. The posterior translation for normal knees was 2 ± 3 mm for the medial compartment and 1.7 ± 4 mm for the lateral. For ACL deficient knees, it was respectively: 1.6 ± 3 mm and 1 ± 4 mm. There was no significant difference in posterior translation according to the condition of the ACL.

The ATMC is more reliable than ATLC for the diagnosis of ACL rupture, with better specificity, sensitivity and predictive values. The cut point is respectively 6 mm and 11.5 mm.

Classification is based on differential ATMC which is divided into 4 grades: grade I, less than 5 mm; grade II, 5 to 8 mm; grade III, 8 to 11

mm; and grade IV, more than 11 mm. Thus, the population is divided into equivalent quartiles, in each one which we can further distinguish 4 grades for lateral compartment laxity (A, B, C, D), using the same ranges. Within each of these groups, ATLC or ATMC can be predominant (internal or external rotation respectively) and sometimes there is large translation of both compartments. Many cases in each category support this classification: I A, 13%; I B, 8%; I C, 4%; and I D, 3%; II A, 11%; II B, 5%; II C, 5%; and II D, 5%; III A, 8%; III B, 4%; III C, 5%; and III D, 6%; IV A, 3%; IV B, 5%; IV C, 8%; and IV D, 5%.

DISCUSSION: Prospective propositions for adapted surgery should be made: In grades I and II, when ATLC is grade A or B, only ACL reconstruction should be performed (38%) and when ATLC is grade C or D, a lateral extraarticular reconstruction should be associated (17%). In grades III and IV, there is an ACL lesion with damage to the posteromedial corner and when ATLC is grade A or B, a medial reconstruction should be associated to ACL (19%). When ATLC is grade C or D, medial and lateral reconstruction should be performed (26%).

CONCLUSION: The evaluation of radiographic knee play provides certain information: i.e., conclusive diagnosis of ACL rupture and a detailed study of the pathological displacements, leading to a laxity classification. It is thus possible to define, for each type of laxity, a surgical treatment adapted to the lesion. It further provides a reference value for assessing effectiveness of surgical treatment.

53. RESULTS OF D-STG ACL RECONSTRUCTION USING THE BONE MULCH SCREW.

***Paolo Aglietti, MD**; Antonio Ciardullo, MD; Francesco Giron, MD; Gianfranco Puddu, MD*

Objective: To evaluate the two-year postoperative results of ACL reconstruction using a double STG graft (D-STG), fixed with the Bone Mulch Screw (BMS) (with bone graft) in the femur and an interference screw plus a spiked washer and bicortical screw in the tibia.

Methods: We operated 108 patients with an isolated ACL tear. Injury-surgery interval was 26 (range 1-180) months. Average age was 28 (range 16-59) years. The IKDC form, anterior tibial translation (KT-1000), and concentric isokinetic strength (Cybex Norm) were evaluated. A radiographic study with image amplifier views was performed.

Results: No patient complained of symptoms during activity and the KT ssd at 30 lbs was 2.4 mm on average with 53% of the knees within 2 mm. Four knees (4%) showed an anterior tibial translation over 5 mm. Some patellar crepitus was found in 15% and was a problem in one patient. Final IKDC score showed 96% satisfactory results. At 60°/sec extensor and flexor strength deficits were 7% on average. An average 8% deficit of internal rotation strength was found at 30°/sec. The tibial tunnel made an angle of 67° (range 58°-75°) with the tibial plateau in the coronal plane and its anterior margin was at 38% (range: 28-50%) of the sagittal diameter of the tibia. The femoral tunnel was not identifiable in most of the cases in the sagittal plane. Tibial tunnel widening was found in 74% of the cases and averaged 30%. Femoral tunnel widening was found in 38% of the cases (frontal view) and averaged 39%.

Conclusions: D-STG fixed with BMS gives very satisfactory results. A very stiff femoral fixation with very low graft-tunnel motion and the use of bone graft decrease tunnel widening.

54. ACL-GRAFT LOCATION AND CLEARANCE.

***Riet Parli**; Hans-Ulrich Staeubli; Wolfgang Rauschning*

Objective: In a prospective study we made an attempt to visualize the ACL-graft location in relation to bony landmarks and reference lines in order to be able to avoid an extension deficit as a result of an anterior misplacement of the tibial tunnel at ACL reconstruction.

Material and Method: In a prospective study, ongoing since 98/04, we used an isotonic, non-toxic contrast dye (Isovist 300) to mark the ACL-graft prior to graft fixation. We documented the ACL-graft position in the sagittal plane with the knee in full extension and with the tibia in a reduced position. On black-and-white printouts from the fluoroscan we measured the anterior-to-posterior limits of the ACL-graft with respect to Blumensaat's line. With 0% at the anterior-most point on the baseline of the tibia we calculated the percentage of the intersections of the intercondylar roof tangent, the anterior ACL-graft limit, the center of the ACL-graft and the posterior ACL-graft limit in relation to the total ap-distance of the tibia. We included 50 patients in the study, 21 women and 29 men with a mean age of 30 $\pm$ 7 years.

Results: The intercondylar roof tangent intersected the baseline at 30 $\pm$ 6% of the ap-distance from the anterior tibial margin, the anterior ACL-graft limit at 42.6 $\pm$ 4%, the posterior ACL-graft limit at 59.9 $\pm$ 4%. The calculated center of the ACL-graft was located at 51 $\pm$ 4% of the ap-distance from the anterior tibial margin. The clearance of the anterior border of the ACL-graft in relation to the intercondylar roof tangent was 12.3 $\pm$ 5% of the measured ap-distance.

Conclusion: We could demonstrate, that in all of our ACL reconstructions a sufficient clearance to the intercondylar roof tangent could be found, which enables a full extension of the knee without impingement of the ACL-graft against the notch-roof. The center of the ACL-graft was with 51% of the ap-distance more posteriorly located than in several publications. Our aim is an individually adapted graft location depending on the femur-intercondylar-roof-angle with a sufficient clearance to the notch-roof of about 12% of the ap-distance. Usually this corresponds to an ACL-graft location in the posterior aspect of the tibial footprint of the native ACL.

55. TIBIAL TUNNEL WIDENING AFTER ACL RECONSTRUCTION: A 2- AND 5-YEAR COMPARISON OF PATELLAR TENDON AUTOGRAFT AND 4-STRAND HAMSTRING TENDON AUTOGRAFT.

***Leo A. Pinczewski, MBBS, FRACS** (a – Australian Institute of Musculoskeletal Research); Richard Stange, MD; Vivianne J. Russell, B.Sc.(Biomed); Lucy J. Salmon, B.App.Sc.(Phty)*

INTRODUCTION: To determine whether the graft choice influences the medium-range behaviour of tunnel shape and widening. Bone-patellar tendon-bone autograft vs. hamstring autograft in interference screw fixation have been prospectively compared in this study.

METHODS: 33 patients were reconstructed with a bone-patellar tendon -bone autograft (BPTB) and 30 patients using a hamstring autograft (HT). All procedures were performed by the same surgeon, with an endoscopic technique, the same fixation technique (7x25 mm RCI-screw) and similar postoperative rehabilitation. Patients underwent a continuous follow-up evaluation including clinical examination, IKDC, Cincinnati knee score and KT-1000 testing. Tibia tunnel widening was measured after 2 and 5 years and calculated using AP and lateral radiographs which were corrected for magnification and evaluated using TurboCAD image software. Tunnel shape was classified according to Peyrache.

RESULTS: At 2-year review a 40% increase in tunnel width was seen in the HT group, which did not significantly change at the 5-year review. In the BPTB group the tunnel width decreased by 15% at 2 years and 26% at 5 years. In the BPTB group the x-ray most frequently showed a cone shaped tunnel whereas the HT group showed a cavity or line shaped tunnel.

CONCLUSION: Tunnel diameter increased after reconstruction using HT autografts in contrast to BPTB autografts, which showed a decrease of tunnel width, although both grafts were fixated in the same

way. Tunnel enlargement may vary dependent on reconstruction technique. It could be reduced by avoiding movement of the graft within the tunnel and reducing the space for the graft within the tunnel, which leads to less expansion of the tunnel.

56. EFFECT OF APERTURE AND DISTAL FIXATION ON THE STRENGTH AND STIFFNESS OF THE BIOLOGIC INTERFACE OF A TENDON IN A BONE TUNNEL FOUR WEEKS AFTER IMPLANTATION: A STUDY IN OVINE. *Wamis Singhatat, MS;* ***Maj. Keith W. Lawhorn, MD, USAF, MC****; M.L. Hull, PhD*

Introduction: Methods to improve healing of a soft tissue anterior cruciate ligament graft to bone may allow earlier and more aggressive rehabilitation and earlier to return to sport. One factor that may affect the healing of a tendon graft in the bone tunnel is the site of fixation. The objective of our study was to determine whether the strength and stiffness of the biologic interface of a tendon in a bone tunnel four weeks after implantation is better with aperture fixation or distal fixation.

Methods: We transplanted the long digital extensor tendon into a 30 mm bone tunnel drilled in the metaphysis of the right tibia in 16 sheep. Aperture fixation was performed with a bioabsorbable interference screw inserted to the entrance (i.e., aperture) of the tunnel (eight sheep). Distal fixation was performed with a WasherLoc applied at the end of the tunnel (eight sheep). Four weeks after implantation the animals were killed, the fixation devices were removed and the strength and stiffness of the biologic interface were determined by incrementally loading the 16 tendon-tibia complexes to failure.

Results: The strength of the biologic interface four weeks after implantation was worse with aperture fixation (131 $\pm$ 78 N) and better with distal fixation (277 $\pm$ 131 N) ($p = 0.03$). The strength of the biologic interface with aperture fixation was only 47% of the strength of the biologic interface with distal fixation. The stiffness of the biologic interface four weeks after implantation was trending worse with aperture fixation (138 $\pm$ 65 N/mm) and trending better with distal fixation (424 $\pm$ 327 N/mm) ($p = 0.06$). The stiffness of the biologic interface with aperture fixation was only 32% of the stiffness of the biologic interface with distal fixation.

Conclusions: The strength and stiffness of the biologic interface of a tendon in a bone tunnel is compromised at four weeks by aperture fixation with a bioabsorbable interference screw. The interference screw "interferes" with the formation of the biologic bond, which may occur because the screw blocks contact between one side of the tendon and the bone tunnel. In contrast, the strength and stiffness of the biologic interface is better with distal fixation (WasherLoc).

Clinical Relevance: If the results of our study are applicable to humans, then the pace of rehabilitation may need to be slowed with aperture fixation of a soft tissue anterior cruciate ligament graft reconstruction. These findings can help clinicians decide whether to use aperture or distal fixation to fix a soft tissue anterior cruciate ligament graft and whether to adjust the pace of rehabilitation.

58. A NOTCH ON THE GREATER TUBEROSITY OF THE HUMERAL HEAD IS USEFUL TO DIAGNOSE ARTICULAR-SIDE PARTIAL ROTATOR CUFF TEAR IN THROWING SHOULDERS. ***Shigeto Nakagawa, MD, PhD****; Minoru Yoneda, MD, PhD; Keiko Kagaya, MD, PhD; Kenji Hayashida, MD, PhD*

PURPOSE: To clarify the significance of a notch on the greater tuberosity of the humeral head in throwing shoulders.

METHOD: Sixty-one baseball players, who had injured their shoulders by repetitive throwing and underwent arthroscopic examination, were studied retrospectively. Their mean age was 21 years. We focused on the presence and features of greater tuberosity notches, rotator cuff tears, and labral lesions on arthroscopy. The relationships between them and several other factors (history of baseball, range of motion, and joint laxity) were examined. Statistical analysis was done using the chi-square test.

RESULTS: Thirty-eight out of 61 patents had greater tuberosity notches, including 15 with small notches, 13 with medium notches, and 10 with large notches. Small notches were always found at the most superior and lateral part of the anatomic bare patch, and large notches were enlarged inferiorly and medially. The presence of a notch was significantly related to the existence of a rotator cuff tear ($p<0.001$), while the size of the notch was significantly related to the depth ($p<0.001$) and width ($p<0.001$) of the tear. However, there was no relationship with the other factors.

CONCLUSION: There is a significant relationship between rotator cuff tears and greater tuberosity notches. A bone reaction at the tear site may be responsible for the notch formation, resembling the osseous changes of insertional tendinopathy.

SIGNIFICANCE: The presence and size of greater tuberosity notches gives us a useful information for the existence and severity of articular-side partial rotator cuff tears in throwing shoulders.

59. ADVANCES IN ARTHROSCOPIC ROTATOR _CUFF SURGERY: RESULTS OF PARTIAL REPAIR AND SUBSCAPULARIS REPAIR. ***Armin Tehrany****; Stephen S. Burkhart*

OBJECTIVE: Our objective was to evaluate the results of arthroscopic partial repair of the rotator cuff.

METHODS: We retrospectively reviewed 12 partial repairs. There were 9 men and 3 women. Average age was 60.7 yrs (42-85 yrs). The dominant arm was involved in 9 patients. Indications for surgery included clinical and/or MRI-confirmed evidence of a rotator cuff tear. Average tear size was 5.4 x 6 cm. An average of 1.7 anchors were used. The operative technique was employed when complete repair was deemed impossible. After arthroscopic tendon mobilization, the torn posterior cuff tissue was shifted superiorly as much as possible onto the greater tuberosity in order to achieve balanced force couples. Additional techniques, such as single or double interval slide were used when necessary.

RESULTS: The patients were followed for an average of 35.2 months (12-76 months). UCLA scores increased from 8.9 to 31.7 ($p<.0001$). Results were good and excellent in ten cases and fair in two. All patients described their pain as minimal to none. Average forward flexion increased from 145° to 160° postoperatively. Three patients had reversal of proximal migration of the humerus. Of the two fair cases, one patient had a positive Napoleon sign, indicating a subscapularis tear; the other patient was a revision case requiring a two-stage procedure. Overall satisfaction was 92%.

CONCLUSIONS: Arthroscopic partial repair of the rotator cuff provides pain relief and functional gains for the patient with a chronic, massive rotator cuff tear. The technique should be considered for tears that are otherwise deemed irreparable.

60. PASSIVE TENSION OF ROTATOR CUFF REPAIRS. *Anthony Bull, PhD; Peter Reilly, FRCS; Roger Emery, FRCS;* ***Andrew Amis, D.Sc***

PURPOSE: To quantify passive tension during open rotator cuff repair and its relationship to post-operative arm position.

METHOD: Ten patients undergoing open surgical reconstruction of the rotator cuff were recruited. The operations were performed by a single surgeon using a standardised technique: acromioplasty, debridement, mobilisation, bone trough and suture tunnels.

An Arthroscopically Insertable Force Probe (AIFP, Microstrain Inc., Burlington, Vermont, USA) was placed at the apex of the debrided tendon. An in situ calibration was performed to relate the output from the AIFP to actual tension in the tendon. The tension generated was recorded as the supraspinatus tendon was advanced into a bone trough and secured.

The relationship between arm position and repair tension was measured, by simultaneously collecting data from the AIFP and a calibrated goniometer. Particular attention was paid to the three standard positions of post-operative immobilisation: full adduction with internal rotation, neutral rotation with an abduction wedge and ninety degrees of abduction.

RESULTS: Repair tension increased significantly with advancement of the supraspinatus tendon into the bone trough. Abduction reduced repair tension, this occurred mainly in the first thirty degrees. Humeral internal rotation at maximum abduction increased repair tension.

CONCLUSION: The tension in the rotator cuff repair can be reduced by the position of post-operative immobilisation.

SIGNIFICANCE: Certain positions of post-operative immobilisation can cause a high load on the repaired rotator cuff tendon. This may contribute to the high rate of failure of rotator cuff repairs.

61. OCD OF THE KNEE: RESULTS OF THREE DIFFERENT SURGICAL TREATMENTS.

Antonio Ciardullo, MD*; Paolo Aglietti, MD; Pierpaolo Cerulli Mariani, MD; Massimo Sangiovanni, MD*

Objective: To evaluate clinical and radiographic results of three different surgical treatments for osteochondritis dissecans of the femoral condyle classified according to ICRS form.

Methods: We investigated 44 knees. Group I included 20 knees with grade III lesions (average age 21 years; range: 12-32) treated with excision of the fragment. Group II included 14 knees with grade II lesions (average age 15 years; range: 14-27) treated with refixation of the fragment with cannulated Herbert screws. Group III included 10 knees (average age 27 years; range:16-54) treated with autologous osteochondral transplantation (AOCT). All patients were evaluated using the ICRS evaluation form and the self-administered Knee Injury and Osteoarthritis Outcome Score (KOOS). Radiographic deterioration was evaluated with A-P in extension weight-bearing views, "tunnel views," P-A view at 45° of flexion views using the Kellgren & Lawrence grading (0-IV). In Group III we also performed an MRI study with a 1.5-T magnet.

Results:

	Group I	Group II	Group III
	Excision	Refixation	AOCT
F.U. yrs (range)	9 (6-17)	7 (1-16)	2 (1-3)
KOOS 0 (abnormal) - 100 (normal)			
Pain	97	94	90
Symptoms	94	94	90
ADL	100	98	95
Sport & Recreation	92	91	76
Quality of life	81	80	66
ICRS Satisfactory (I-II)	85%	100%	90%
P-A X-Ray deterioration	15%	14%	20%

Conclusions: Clinical results were better in Group II and III compared to Group I while radiographic evaluation showed slightly more cartilage deterioration in Group III. MRI revealed an incomplete integration of plugs for defects $\geq$ 3 cm2 ($p=.02$).

62. A PROSPECTIVE RANDOMIZED STUDY ON CHONDROCYTE TRANSPLANTATION IN COMPARISON WITH OSTEOCHONDRAL TRANSPLANTATION.

Dalip Pelinkovic*; Uwe Horas; Thomas Aigner; Reinhard Schnettler*

Background: Current methods used to restore the joint surface in localized articular cartilage defects of the knee joint comprise autogenous osteochondral cylinder transplantation (OCT) and autologous chondrocyte implantation (ACI), which are supposed to enable a hyaline cartilage defect covering.

Methods: This prospective clinical study investigates the 2-year-outcome of patients, who underwent either ACI or OCT for the surgical treatment of articular cartilage lesions. Forty patients are evaluated with regard to clinical outcome. Biopsies from representative patients of either group were evaluated by histology, immunohistochemistry, and scanning electron microscopy.

Results: We found equally good results with both methods for Lysholm, Meyers, and the Tegner activity score. Histomorphologic evaluation of arthroscopically obtained biopsies two years after ACI in 8 patients demonstrated a complete, mechanically stable resurfacing of the defect in all cases. The tissue consisted mainly of fibrous cartilage, while localized areas of hyaline-like regenerative cartilage could be detected close to the subchondral bone.

We did not see any histomorphologically or scanning electron microscopically detectable differences between the autogenous osteochondral transplant itself and the surrounding original cartilage in all 5 biopsied patients 2 years postoperatively. The interface between transplant and surrounding original cartilage demonstrated that an almost areactive gap remained.

Conclusion: In most cases ACI resulted in a complete covering with fibrocartilage. Only close to the subchondral bone could a hyaline-like microstructure be detected.

Due to the non-hyaline like quality of the regenerated tissue following ACI, we propose to intensify experimental research with the aim of regenerating hyaline cartilage.

63. INVESTIGATION OF TWO TECHNIQUES FOR OPTIMISING JOINT SURFACE CONGRUENCY FOLLOWING ARTICULAR RESURFACING WITH MOSAIC ARTHROPLASTY.

Anthony Miniaci, MD, FRCSC

INTRODUCTION: Mosaic arthroplasty is an exciting innovation in articular cartilage resurfacing whereby hyaline cartilage with intact subchondral support is supplied directly to the joint defects. Multiple dowels can be harvested and arranged, similar to tiles in a mosaic, to reconstruct defects. This technique has been used extensively to treat focal osteochondral defects in human patients. Failure to achieve congruency of the individual graft with the joint surface is associated with graft subsidence and failure. The objective of this study was to investigate two techniques for achieving optimal joint congruity.

MATERIALS & METHODS: Thirteen mature female sheep were randomly assigned to either proud or flush treatment groups. Precision instrumentation from Acuflex was used to harvest 3 osteochondral grafts from the axial aspect of either trochlear ridge. The grafts were then implanted in a created circular defect at a standard site on the medial femoral condyle (total of 39 grafts). In the proud treatment group, grafts delivered to the donor site were left protruding 2 mm above the level of the surrounding cartilage. Sheep were sacrificed at 3 months postoperatively, and the grafts were subjectively assessed grossly, and histologically (stained with Masson's trichrome and toluidine blue). In addition, the cartilage was scored according to a modified Mankin scoring technique which included estimates of cartilage cellularity, matrix staining, surface erosion, and subchondral support.

Analysis of variance was used to test for significant differences between treatment groups for objective data using procedures for the general linear model in SAS 6.1 for Windows. Articular cartilage was also saved for biochemical analysis.

RESULTS: On gross examination, there was good retention of cartilage in 33 of the 39 grafts. The perigraft area of the proud group contained less cartilage, more mature fibrous tissue and increased cleavage between grafts compared with the flush group. Histologically, the grafts from both groups had good cartilage retention, and there were only mild decreases in both cartilage matrix and cellularity. Some grafts were imperfectly aligned with regard to the surrounding cartilage. In particular tipping of one edge of a graft, or a minor subsidence was noted. Subchondral cysts were observed in sections from 5 of the 13 sheep, which were surrounded predominantly by fibrous tissue with some islands of cartilage. There were no significant differences between groups with regard to the Mankin scoring of the graft cartilage.

DISCUSSION: This experiment presents results on resurfacing over a relatively short (3 month) post-treatment period, and it is possible that more extreme differences would have been evident after a longer period. However, the large number of viable grafts in this study support other studies that mosaicplasty is a useful method of resurfacing focal articular cartilage defects. A possible explanation for the lack of statistical differences in the Mankin scoring between proud and flush techniques, may be that both techniques had different potential problems resulting in similar histomorphological abnormalities. Damage to grafts in the proud group was associated with excessive toggle of the grafts in the recipient holes and large clefts between grafts. These clefts were associated with subchondral support for the grafts. Flush grafts with accurate alignment of the graft cartilage with surrounding articular cartilage resulted in the best defect repair.

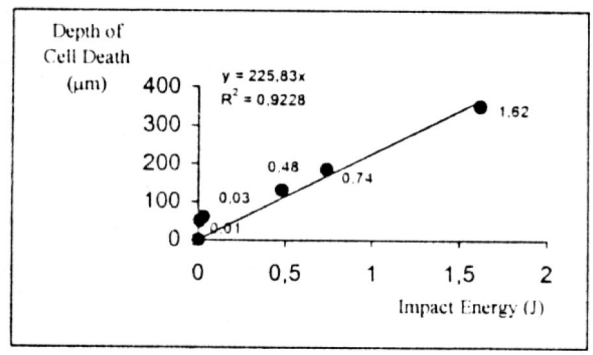
64. MAY MOSAICPLASTY INSTRUMENTATION AFFECT VIABILITY OF TRANSPLANTED PLUGS?

Emmanuel Gautier; Roland Jakob; ***Pierre Mainil-Varlet***

Introduction: In the last five years, autologous osteochondral transplantation (OCT) has increasingly gained popularity in cartilage repair. Cylindrical osteochondral grafts are removed from a donor site and transported to the recipient site. In order to obtain satisfactory primary stability a press fit fixation technique is used. During this procedure, a significant impact load is necessary to insert the grafts. The effect of repeated impact loads on the potential development of osteoarthritis has been previously documented. The aim of the present study is to investigate the effect of single impact during OCT on cell viability and matrix integrity.

Material and Methods: Fresh bovine knees were collected from a local butchery 6-12 hours post-mortem. Osteochondral plugs were harvested under continuous PBS irrigation with a hollow drill-bit (diameter 6.4 mm) and left in situ. With a custom-made impactor system, a defined impact was generated on the surface of the osteochondral plugs. To generate different impact loads the mass and/or the spring pretension were adjusted appropriately. Impacts were controlled to be parallel to the cartilage surface and were randomly distributed on the entire surface of lateral and medial condyles. Ten osteochondral plugs per impact force level were investigated. Control plugs (without impact) were also harvested. Plugs were analysed with live/dead test (cell viability) (Molecular ProbesR) under confocal microscopy (Zeiss 400) and with standard histological method evaluated (Masson-trichrome, Safranin-O and Alcian-blue).

Results: Control plugs appeared to have a normal level of cell viability (2-3% death) under confocal analysis. Standard histology also revealed normal hyaline cartilage structure. After impaction, confocal microscopy enabled a clear distinction between viable and dead chondrocytes, which was difficult to determine using standard histology. A linear correlation between impact energy and depth of cell death was identified (Fig. 1). Under standard histology matrix fissures were identified, which were oriented approximately 45° relative to the cartilage surface, and were adjacent to the impacted cartilage. With higher impaction energy, superficial fissures were aligned parallel to the surface such that pieces of cartilage were almost detached from the underlying tissue. A greater concentration of cell death was observed in the area where the matrix was damaged.



Conclusions: The sensitivity of confocal microscopy examination allowed the visualization of cell death due to impact in samples without histological matrix disruption. Maximal impact energy per area on the cartilage surface depends on numerous factors including orientation of the impactor, impactor diameter, subchondral bone density, cartilage thickness, cartilage mechanical properties and the size of press fit. The surgeon should therefore aim for the lowest possible impact energy, an optimal press fit and a correct graft positioning during OCT. It is important to emphasise that cell death does not preclude OCT implantation. Indeed allograft implantation has shown satisfactory long-term results. Matrix destruction is certainly more problematic because of potential implant delamination. This study shows the effect of single impact loads on metabolic activity of chondrocytes in situ. Further studies are necessary to determine how these changes will affect long-term performance of OCT.

66. RELIABILITY OF THE ROLIMETER.

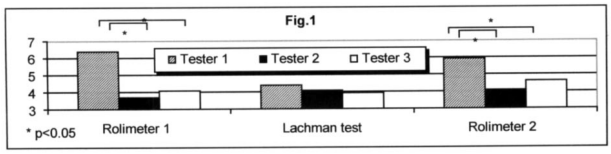
Thomas Muellner, MD*; Wilhelm Bugge; Steinar Johansen; Lars Engebretsen*

Purpose: To evaluate the inter- and intra-tester reliability for a new device, the Rolimeter Kneetester.

Method: Three testers (2 experienced, 1 inexperienced) examined both knees of 10 volunteers with the Rolimeter (Aircast Europe, Neubeuern, Germany), then after 1.5 hours clinically using the Lachman test, and again with the Rolimeter. 3 measurements were taken and the average calculated. Tester 1 stabilized the patella pad with the thumb, a technique similar to the Lachman test, while testers 2 and 3 used a technique similar to the suggested method for the KT-1000 arthrometer. For statistical analysis an ANOVA for repeated measures and a Bonferoni corrected paired t-test were used. A p-value of less than 0.05 was considered statistically significant.

Results: Between tester 1 and testers 2 and 3 significant differences were found. Between testers 2 and 3 no significant differences were found neither for the first trial ($p=0.48$), nor for the second trial ($p=0.66$). The intratester evaluation revealed no significant differences

for any of the testers (tester 1: p=0.91; tester 2: p=0.48; tester 3: p=0.57). The clinically estimated anterior displacement values showed no significant differences when related to the instrumented measurements for testers 2 and 3 (all p>0.3), while tester 1 underestimated his instrumented measurements significantly (p<0.002) (Fig. 1).



Conclusion: As no significant difference could be found in the intra-tester evaluation, the Rolimeter seems to represent a reliable tool for instrumented stability testing. The inter-tester differences are explained by the different technique tester 1 used.

Significance: Even inexperienced testers can use the Rolimeter and obtain reliable results compared to an experienced tester and during repeated measurements. The Lachman test like technique cannot be recommended to evaluate anterior translation with the Rolimeter.

67. MEASUREMENT OF ANTERIOR-POSTERIOR KNEE LAXITY: A COMPARISON OF THREE TECHNIQUES.

Braden C. Fleming, PhD *(a – dj Orthopaedics LLC); Bjarne Brattbakk; Bruce D. Beynnon, PhD; Glenn Peura, MS*

Objective: Several non-invasive techniques have been developed to assess knee joint instability, however their accuracy for clinical assessment remains questionable. Radiostereometric Analysis (RSA) has been proven to be an accurate and precise tool to evaluate anterior-posterior (A-P) knee laxity. Thus, RSA provides a "gold standard" that can be used to evaluate other less invasive techniques. The objective or this study was to compare A-P laxity measurements using RSA (RSA Biomedical AB, Umea, Sweden), the KT-1000 Knee Arthrometer (MedMetrics Corp, San Diego, CA), and planar stress x-ray analysis. The hypotheses were: 1) the A-P laxity values between measurement techniques are equal, and 2) high correlations exist between the laxity measurements of the KT-1000 and planar stress x-rays with RSA.

Methods: 15 subjects who underwent ACL reconstruction participated and all subjects granted their informed consent. During surgery, tantalum were inserted into the proximal femur and distal tibia. The subjects returned for follow-up visits at 3, 6, and 12 months. A total of 27 follow up visits have been completed. The A-P laxity values for the reconstructed knees were evaluated at each follow-up using the three measurement techniques. A-P laxity was defined as the total A-P translation of the tibia between the load limits of -90 N (posterior) and 130 N (anterior). The subjects knees were flexed at 20° during the test. The arthrometer was used by an experienced examiner following the manufacturer's instructions. For the planar stress analysis and RSA, the knee was positioned within the RSA knee calibration cage (Cage 10; RSA Biomedical). Simultaneous biplanar films (A-P and sagittal views) were taken as the posterior and anterior directed shear loads were applied. For planar stress analysis, the sagittal plane films were used. As described by Staubli (1992), the posterior aspects of the medial and lateral, femoral and tibial condyles; were identified and digitized. A-P laxity was then calculated as the average displacement of the femoral condyles with respect to the tibial condyles. For the RSA, the tantalum beads were identified, digitized, and reconstructed in three-dimensions from the biplanar x-rays. A-P translations were calculated by determining the motion of the tibial eminence and cluster of tantalum beads relative to the femoral cluster. A two-way analysis of variance compared laxity values of the measurement techniques. Linear regressions were performed to establish the relationships between the arthrometer, planar stress analysis, and RSA.

Results: The mean A-P laxity values for the three techniques were significantly different (p<0.001). The mean (+/- 1 standard deviations) were 11.1 (2.47), 9.6 (2.88), and 7.3 (1.99) mm for the arthrometer, planar stress analysis and RSA techniques. There was no significant correlation between the A-P laxity values as measured by the KT-1000 and the RSA (r2 = 0.13), however, a significant correlation was found between the planar stress analysis and RSA (r2 = 0.46).

Conclusions and Significance: Three commercially available knee laxity measurement techniques that are commonly used to evaluate ligament function were evaluated. The extremely low coefficient of determination between RSA and the arthrometer questions the use of the device to evaluate A-P laxity in clinical research studies where precise measurements may be required. RSA provides the best means to evaluate A-P knee laxity in clinical studies.

Acknowledgment: This study was funded by grants from the National Institutes of Health (AR45027), the Arthritis Foundation and the Patient Oriented Research Program at Fletcher Allen Health Care, Burlington, VT.

68. COMPARISON OF MECHANICAL STRENGTH AND STIFFNESS OF DIFFERENT TAPES UTILIZED FOR TIBIAL FIXATION IN ACL LIGAMENT RECONSTRUCTION.

Alberto Gobbi, MD*; Stefano Santamaria, MD; Sanjeev Mahajan, MS*

PURPOSE: Was to analyse a new type of tibial fixation for hamstring graft in ACL reconstruction with the aim to achieve an accelerated rehabilitation programme.

METHODS: The two tapes (mersilene 5 mm and new ortho tape 3 mm) with three different constructs were connected with a particular staple on fresh bovine cadaveric tibia. These constructs underwent straight, residual ultimate tensile test and fatique test (540,000 cyc., 25 Hz) at cyclic loading of 150, 300 and 600 N with an Instron 8031 tensile test machine. Stiffness, protrusion height of the staples and extension to failure of different constructs were analysed under different loads.

RESULTS: Construction with mersilene tape was weaker than the one with the new tape (ultimate tensile strength of 448.56 N versus 900.74 N) and less stiff (97.53 N/mm versus 126.26 N/mm). We obtained the best construction with a double loop of the ortho tape fixed on tibial side with a specific metallic staple.

CONCLUSIONS: We conclude that this Ortho tape construct should be considered as a good option for tibial fixation in ACL reconstruction as this can withstand high pullout strengths when using hamstring graft. With this construct aggressive rehabilitation program can be suggested.

69. PRECISION AND REPEATABILITY OF ACL TUNNEL PLACEMENT FOR COMPARISON OF ROBOTIC AND TRADITIONAL TECHNIQUE.

Andreas Burkart *(a – Orto Maquet GmbH); Rich Debski; Patrick McMahon; Freddie H. Fu*

Purpose: In this study we compared the repeatability of tunnel placement for ACL reconstruction using two techniques: 1) CASPAR (Orto Maquet, Inc) – an active robotic system, and 2) an experienced surgeon.

Methods: Twenty knees (Sawbones, Inc.) from the same mold were customized by including a reference cube in the medial aspect of the proximal tibia and distal femur. The tunnels for ACL reconstruction were then drilled using either the robotic (10) or traditional (10)

technique in a random order. For the robotic procedure, a reference screw was placed in the femur and tibia and a CT scan was performed. Tunnel placement was determined using predefined criteria and the CASPAR planning station. For the traditional procedure, the surgeon's preferred technique was used to place the tunnels. The position of the tunnels relative to the reference cube was then determined with a 6 degree-of-freedom measurement device.

Results: The absolute location of tunnel placement and the direction of the tunnels between traditional and robotic technique were found to be significantly different ($p<0.05$). Insertion points on the tibia were located inside a sphere of radius 3.42 mm and 2.01 mm using the traditional and CASPAR techniques, respectively. The difference between the size of each sphere was statistically different ($p<0.05$). However, no significant differences ($p>0.05$) could be shown for the size of the sphere on the femoral side (traditional: 2.34 mm vs. CASPAR 2.08 mm).

Conclusion: CASPAR seems to be highly repeatable and could be useful for ACL reconstruction. We believe the variation in the CASPAR may come from CT-data and planning.

70. DETERMINATION OF THE GRAFT TENSION TO RESTORE NORMAL LAXITY IN ACL RECONSTRUCTION USING AUTOGENOUS HAMSTRING TENDONS. ***Tatsuo Mae, MD****; Konsei Shino, MD, PhD; Masayuki Hamada, MD, PhD; Ken Nakata, MD, PhD*

OBJECTIVE: To determine the graft tension to restore normal anterior-posterior (A-P) laxity in ACL reconstruction using quadrupled hamstring tendons via two femoral sockets.

METHODS: The subjects were 12 patients with a mean age of 27 suffering from unilateral ACL insufficiency. The experiment was performed under general anesthesia during the endoscopic two-femoral-socket ACL reconstruction using quadrupled semitendinosus tendon. On the femoral side, the graft was fixed with two Endobuttons® via the two sockets created at 9:30 and 11 o'clock, or 1 o'clock and 2:30 of the ACL femoral footprint. At the tibial side, the graft was temporarily fixed to the tension-adjustable force gauge installed on the tibial cortex using polyester sutures placed to the graft's distal ends. The graft tension was set at 0, 10, 20, 30, 40 or 50N at 20° of flexion, and the A-P laxity was measured using Knee Laxity Tester® by applying A-P drawer load (up to 132N) at 30° of flexion. The laxity for the opposite healthy knee was also measured.

RESULTS: The A-P total laxity was 18.4, 14.7, 13.8, 12.8, 11.5, and 10.2 mm for the graft tension of 0, 10, 20, 30, 40, and 50 N respectively, while that for the contralateral normal knee was 13.2 mm on the average.

DISCUSSION: Our data suggest that the graft tension to restore normal A-P laxity was approximately 25N in two-femoral-socket ACL reconstruction using quadrupled hamstring tendons. While it is not our intention to recommend applying this laxity-matched tension to grafts, this data will be helpful to optimize the graft tension in the future.

71. BONE INJURY ASSOCIATED WITH ANTERIOR CRUCIATE LIGAMENT AND MENISCAL TEAR. ASSESSMENT WITH SPECT BONE SCINTIGRAPHY. ***Ron Arbel, MD****; Nahum Halperin, MD; Einat Even-Sapir, MD*

Single photon emission computed tomography (SPECT) bone scintigraphy of the knees was performed in ninety-four patients with a suspected anterior cruciate ligament (ACL) and/or meniscal tear. The accuracy of SPECT in detecting ACL or meniscal damage was assessed by correlation with arthroscopy (seventy-four cases) and in detecting associated bone injury by correlation with magnetic resonance imaging (MRI) (thirty-seven cases). SPECT images detected no abnormality in eleven of twelve patients with normal arthroscopy, and no patients with an abnormal arthroscopy had a normal SPECT. An ACL tear was characterized on SPECT images as increased uptake in the posterior aspect of the lateral tibial plateau (LTPp) with a sensitivity of 97 percent, a specificity of 92 percent, positive predictive value (PPV) of 93 percent and a negative predictive value (NPV) of 97 percent. A tear of the medial meniscus was characterized as increased uptake, mainly crescent shaped, in the medial tibial plateau (MTP), with a sensitivity of 91 percent, a specificity of 65 percent, a PPV of 78 percent and an NPV of 83 percent. Increased uptake through the LTP was specific for a tear of the lateral meniscus, but this finding was identified in only one-half of the patients. Diagnosis of a tear of the lateral meniscus was difficult on SPECT, particularly in the presence of a concomitant ACL tear.

All seven cortical fractures and 79 percent of thirty-four sites of bone bruise identified on MRI corresponded in location to foci of high intensity increased uptake on SPECT. In twenty-eight patients with an ACL tear, accompanying bone injury was identified on MRI in eighteen (64 percent). SPECT detected a high intensity increased uptake in all but one patient with MRI evidence of bone bruise and in two additional patients with an ACL tear without bone bruise on MRI . Intensity of uptake in the LTPp due to an ACL tear with bone bruise was significantly higher than uptake due to an ACL tear alone (mean intensity 1.4 ± 0.8 compared with 2.4 ± 0.7, $p < 0.01$). In addition to sites of high intensity increased uptake corresponding to sites of bone bruise on MRI, SPECT images detected an additional eleven sites of high intensity increased uptake not identified on MRI, eight in the LTPp and three in the LFC.

The results of this study suggest that SPECT may be used as an alternative or complementary modality for assessment of bone injury associated with acute knee injury.

72. THE POTENTIAL ADVANTAGES OF AN ANATOMICAL ACL RECONSTRUCTION. ***Masayoshi Yagi, MD****; Eric K. Wong, BS; Freddie H. Fu, MD; Savio L-Y Woo, PhD*

PURPOSE: The objective was to evaluate the biomechanical characteristics of a more anatomical ACL reconstruction, i.e., reproducing both the AM and PL bundles of the ACL, and to compare the results with a more traditional single bundle (S-B) reconstruction.

METHODS: Ten cadaveric knees (44-60 yr.) were tested utilizing robotic technology. For anatomical reconstruction, semitendinosus and gracilis graft were placed into two femoral tunnels, while S-B reconstruction utilized a single femoral tunnel using the same graft and fixation. Two external loading conditions were applied with the knee at 30° of flexion: 134N anterior tibial load (anterior loading) and combined rotatory load of 5N-m internal tibial torque and 10N-m vaIgus torque (rotatory loading). Anterior tibial translation (ATT) and in-situ force of the ACL and the replacement grafts were determined. Data were analyzed using a repeated measures ANOVA ($p<0.05$).

RESULTS: In response to both loading conditions, normalized ATT to the intact knee is shown in Figure 1. With the anterior load, in-situ forces for S-B and anatomical reconstruction were 89 ± 13 and $97\pm9\%$ of the intact ACL, respectively, and they were 66 ± 40 and $91\pm35\%$, respectively during rotatory loading. In both cases, the in-situ force in the anatomical reconstruction graft was significantly higher than in the S-B reconstruction ($p<0.05$).

CONCLUSION: The results show that the anatomical reconstruction, which is more like the intact ACL, can more closely restore knee

kinematics and reproduce the in-situ forces in the graft than the traditional one bundle reconstruction method.

SIGNIFICANCE: These findings suggest that a new anatomical ACL reconstruction procedure should be designed in the hope of gaining better clinical outcome.

FIGURE 1: Normalized anterior tibial translation to the intact knee in response to anterior and rotatory loading.

73. INTRAOSSEOUS HEALING OF THE FLEXOR TENDON GRAFT IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION – THE EFFECT OF INTRAOSSEOUS GRAFT LENGTH. ***Shuji Yamazaki, MD****; Kazunori Yasuda, MD, PhD (a – Kyocera Co. Ltd.); Harukazu Tohyama, MD, PhD; Fumihisa Tomita, MD; Akio Minami, MD, PhD*

PURPOSE: To clarify effects of length of the flexor tendon (FT) graft placed in the bone tunnel on intraosseous graft healing in ACL reconstruction.

METHOD: Fourteen beagle dogs were divided into two groups of 7 animals each. For each animal, ACL reconstruction was performed using the doubled FT graft in the left knee. The length of the graft located in the tibial bone tunnel was 5 mm in Group S, while it was 15 mm in Group L. In the right knee, ACL reconstruction was performed with the standard BTB graft procedure in each group. All animals were sacrificed at 6 weeks. Pull-out testing of the graft from the tibia were performed after sutures tethering the graft to the tibia were cut.

RESULTS: 1) There were no significant differences in the ultimate load of the FT graft-tibia complex between the two groups (254 $\pm$ 99 N in Group S, 205 $\pm$ 32 N in Group L). 2) The perpendicular collagen fibers resembling Sharpey's fibers were abundantly generated surrounding the intraosseous graft end in Group S, while the fiber generation was localized just at the proximal (approximately 5 mm long) portion of the graft in Group L.

CONCLUSIONS: In ACL reconstruction with the FT graft, the intraosseous graft length did not affect the pull-out load of the graft. This phenomenon may be explained by localization of the fiber-rich zone or the graft-bone interface within the tunnel.

SIGNIFICANCE: To increase the anchoring strength of the FT graft, it is not an effective strategy to place an excessively long graft in the tunnel.

74. THE SEMITENDINOSUS TENDON REGENERATES AFTER RESECTION, A MORPHOLOGIC AND MRI ANALYSIS. ***K. Eriksson****; L.G. Kindblom; P. Hamberg; H. Larsson; T. Wredmark*

Objective: To histologically describe the regenerated semitendinosus (ST) tendon tissue after it previously has been harvested in its whole length for anterior cruciate ligament (ACL) reconstruction. Previous MRI studies have indicated a strong regeneration potential but until now no other evidence for actual regeneration exists.

Methods: 6 patients with previous (20$\pm$9 months) ACL reconstructed knees, where a quadruple ST tendon graft had been used as transplant, were included. In 5 patients a recent MRI had revealed a regenerated ST tendon and in one patient no obvious regenerate was present. In all patients open surgical exploration dorsomedially and slightly proximal to the knee joint was performed, the findings photographically documented and in the 5 patients with a present regenerate biopsies were obtained from the regenerated ST tendon tissue.

Results: Macroscopically the tendon tissue appeared nearly normal in all 5 patients with a visualized regenerate of the tendon. In the one patient where no regenerate was seen on the MRI no tendon or scarring tissue was found. Histologically the 5 regenerated tendons resembled tendon like tissue with normal collagen arrangement. In some areas of the specimens scarring tissue and neovascularisation was present but always surrounded by more or less normal tendon like collagen structure.

Conclusion: Histological evidence of ST tendon regeneration following its resection in ACL surgery is now present.

75. SEMITENDINOSUS AND GRACILIS TENDON REGENERATION AFTER HARVESTING FOR ACL RECONSTRUCTION. ***G. Zaccherotti****; M. Olmastroni; M. Battaglini*

PURPOSE: To evaluate hamstrings tendon regeneration after harvesting for ACL reconstruction using MRI and to compare these data to a Cybex II muscle strength evaluation both in flexion and in the internal tibial rotation.

METHOD: Twenty consecutive, chronic and isolated ACL lesions which underwent reconstruction with a quadrupled Semitendinosus (ST) and Gracilis (G) graft were examined. MRI investigation was performed using 20 Spin-Echo T1 and a turbo Spin-Echo DP transaxial sequences over the thigh at 1 month and 7 months after surgery. The signals were compared to those obtained from the contralateral healthy thigh. Cybex II concentric evaluation at 60° and at 180°/sec for the flexion strength and at 30°, at 60° and at 120°/sec for the internal tibial rotation strength was done 7 months after surgery.

RESULTS: After 1 month, a clear regeneration of the tendons was found in 12 (60%) patients. In 4 (20%) cases the signal was not clearly "tendinosus" and in 4 (20%) the signal was absent. At 7 months we found a definite tendon signal in 14 (70%) cases and absent in 6 (30%) cases. In cases with regeneration, the ST was present below the joint line (4 mm and 18.8 mm at 1 month and 7 months, respectively), while the G overstepped the joint line only after 7 months (-2 mm and 13 mm at 1 month and 7 months, respectively). In the contralateral thigh, the signal exceeded the joint line in all cases for both tendons (36 mm from the joint, $p<.001$). Flexion deficit was 5.9% and 4.5% at the two speed tested (n.s.); the internal tibial rotation deficit was 20% ($p<.001$), 17.7% ($p=.03$) and 10.8% ($p=.05$) at the three speeds tested. In cases with no tendon regeneration, the flexion deficit was significantly higher than in the regeneration group (15.2% vs. 2.2% at 60°/sec, $p<.001$); there was also a significant difference compared to the contralateral knee ($p=.04$). The internal tibial rotation strength deficit was significantly higher in comparison to the contralateral in both the no regeneration or regeneration cases [27.7% ($p<.001$) and 17% ($p=.01$) respectively at 30°/sec] with no statistical differences between the two groups.

CONCLUSION: The ST and G tendon have a clear potential for regeneration (70% of the cases). The progression of regeneration is from the muscle to the tibia. In absence of regeneration, the recovery of muscle strength is not optimal neither in flexion nor in internal tibial rotation. In cases of tendon regeneration, the strength in flexion is practically recovered but a deficit in the internal tibial rotation strength was found.

SIGNIFICANCE: At 7 months follow-up, although the tendon regenerates there is not a complete restoration of the anatomy of the tendon on its insertion around the tibial metaphysis. It may reduce the internal tibial rotation effect of the hamstrings.

77. MICROMOTION OF THE TIBIAL BONE PLUG AFTER ACL RECONSTRUCTION WITH BTB-PT AUTOGRAFT. A PROSPECTIVE CLINICAL STUDY USING RSA. ***Frank Adam, MD****; Dietrich Pape, MD; Oliver Steimer; Dieter Kohn, Prof.*

Purpose: To evaluate postoperative micromotion of the tibial boneplug under clinical conditions using high accuracy RSA.

Material and method: 10 succeeding patients (9 men, 1 woman) with an average age of 32 years (20-50) and a minimum follow-up of 6 weeks after isolated ACL rupture were included in the prospective study. All patients underwent arthroscopic ACL reconstruction with a

BTB-PT autograft. Tibial bone-plug was prepared with 3 tantalum balls. Tantalum markers were also inserted in the tibia through the tibial bone defect. The bone-plug was fixed with an interference-screw in outside-in technique. Reference RSA measurement was performed immediately after surgery. All patients were examined by RSA 1, 2, 3, 6 months and 1 year postoperatively. The micromotion of the tibial bone-plug related to the tibia was measured with RSA.

Results: In 4 cases no measurable micromotion of the bone-plug was observed. Only 3 patients showed a slight migration of 0.2, 0.4 and 0.9 mm in line with the graft during the first 4 weeks. In 6 cases a micromotion in the dorso-ventral direction averaging 0.46 mm (0.2 - 1.32) was seen related to the position of the screw. No breakage or lengthening of the bone plug itself was seen. After the eighth week no further migration of the bone plug was observed.

Conclusion: In several cases the bone plug migrated in the cancellous bone of the tibia caused by pressure of the screw. From 8 weeks postoperatively on the bone plug showed bony ingrowth without any detectable micromotion.

78. POSTOPERATIVE RESULTS OF ACL RECONSTRUCTION: BPTB VS. D-STG. ***Francesco Giron, MD****; Paolo Aglietti, MD; Roberto Buzzi, MD; Flavio Biddau, MD*

Objective: To assess differences in results one year after ACL reconstruction performed using a BPTB or a D-STG graft.

Methods: 80 knees with a chronic isolated ACL lesion were randomly assigned to one of the two graft choices. Both groups were comparable in terms of age at surgery, injury-surgery interval, activity level, gender and surgical technique (endoscopic trans-tibial). All patients were evaluated using the IKDC form including the new subjective section, the KT-1000 dynamometer, Cybex NORM testing for concentric isokinetic strength. The Functional Score for Anterior Knee Pain (S. Werner) and the Activity Rating Scale (R. Marx) were also included.

Results:

	D-STG	BPTB
IKDC SUBJECTIVE (0-100 Normal)		
(Symptoms, Sports Activity, Function)	84	80
IKDC EXAMINATION (A, Normal)		
Effusion	100%	100%
Motion	100%	95%
Stability (0-2 mm)	59%	58%
KT-1000 ssd 30 lbs	2.3 mm	2 mm
Cybex test: Quad strength deficit 60°/sec	23%	24%
Hams strength deficit 60°/sec	12%	5%
Internal rotation deficit 30°/sec	22%	15%
Patella Score (0-50 Normal)	44	35
Kneeling discomfort (p=.001)	4%	58%
Activity Rating Scale (0-16)	10	11

Conclusions: The subjective evaluation showed slightly less pain and symptoms in the D-STG group. The objective evaluation showed no significant differences between groups in all the analysed parameters except for kneeling discomfort.

79. 10 to 16 YEAR FOLLOW-UP RESULTS FOR 100 ACL RECONSTRUCTIONS FOR CHRONIC INSTABILITY OF THE KNEE USING ONE THIRD OF THE PATELLAR TENDON AUGMENTED BY EXTRA-ARTICULAR PLASTY ("MAC INJONES PROCEDURE"). ***J.L. Lerat****; F. Chotel; B. Moyen; J.L. Besse*

PURPOSE: The aim of this prospective study was to evaluate, with a minimum of 10 years' follow-up (mean = 11.7 ± 2 years), the objective post-operative laxity and functional results of chronic anterior instability treated by anterior cruciate ligament (ACL) reconstruction plus lateral extra-articular plasty.

METHODS: 100 patients, with a mean age of 27.8 ± 8.5 years, were operated. The mean injury-to-operation interval was 4 ± 4.8 years. Surgery employed the MacInJones procedure, with bone-to-bone fixation of a free autologous patellar tendon graft, supplemented by lateral extra-articular plasty using a strip of quadriceps tendon as a direct prolongation of the graft of the patellar tendon and patella itself. A rehabilitation program sought early recovery of a complete range of motion. Anterior laxity was measured pre- and post-operatively by two instrumental methods, KT-1000 arthrometer and stress-radiography (at 20° flexion with a 9 kg load applied at the distal part of the thigh), in the medial and lateral compartments. Tunnel positions were assessed by X-ray. Functionality was assessed in terms of the International Knee Documentation Committee (IKDC) score.

RESULTS: The reconstructed ligament tended to elongate mainly during the first 6 post-operative months, but this was independent of early recovery of a full range of motion. Laxity stabilized after 1 year. The final laxity gain was 62% for the medial and 77% for the lateral compartment. The pivot-shift test came out as negative in 66% of cases, grade 2 in 4% and grade 1 in 30%. Functional results were excellent or good (IKDC grades A and B) in 60.4% of cases, and 76.7% of patients were able to resume sports. 12 reconstructed ligaments re-ruptured. Arthritis caused poor results in 13.8% of cases. The lateral extra-articular plasty failed to control medial compartment translation better than would isolated ACL reconstruction, but lateral compartment laxity and pivot shift were minimized. Incorrect ACL positioning correlated with poor results.

CONCLUSION: This documented study of laxity in the two compartments confirms the interest of each type of reconstruction, and in particular of extra-articular plasty using the quadriceps tendon and thus preserving the ilio-tibial band and the control of varus stability.

80. KNEE STABILITY AND BONE TUNNEL _ENLARGEMENT AFTER ANATOMICAL ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION. ***Tomoyuki Sasaki, MD****; Seiko Harata, MD; Yasuyuki Ishibashi, MD; Hironori Otsuka, MD*

PURPOSE: The purpose of this study was to evaluate the knee stability and the bone tunnel enlargement at one year after anatomical ACL reconstruction.

METHODS: One hundred thirty-six patients (99 male, 57 female) with an average age of 23.7 years (range 11 - 45 years) underwent ACL reconstruction with bone-patellar tendon-bone autograft (BTB). In Group I (anatomical reconstruction), a bone core, which was harvested from the tibial tunnel, was grafted just proximal to the distal bone block of BTB (56 patients); in Group II, traditional endoscopic reconstruction without grafted bone core was performed (80 patients). Each group was evaluated for side to side difference of the tibia with KT-1000 arthrometer and tibial bone tunnel width by digital caliper on X-ray at 12 months postoperatively. Data analysis was performed using an unpaired t-test.

RESULTS: Side to side differences of KT-1000 were 0.9 +/- 0.9 mm in Group I and 1.9 +/- 0.8 mm in Group II. The displacement in Group I tended to decrease more than in Group II, but the difference was not significant. The mean tibial bone tunnel width on X-ray was 9.7 mm in Group I and 11.9 mm in Group II. Group II had a more significant tibial tunnel enlargement than in Group I ($P<0.05$).

CONCLUSION: ACL reconstruction fixed in the anatomical position, using BTB with a bone core, improved knee instability and tibial bone tunnel enlargement. However, further long-term follow-up study is required to determine the relationship between knee instability and tunnel enlargement.

80B. MUSCLE BASED EX VIVO GENE THERAPY OF KNEE JOINT ARTHRITIS. ***Dalip Pelinkovic**; Vladimir Martinek; Freddie H. Fu; Johnny Huard*

Since the knee joint sustains many of these conditions, gene therapy to the joint as a drug delivery system will be an important accomplishment. A gene therapeutic therapeutic model has two major advantages over the current palliative treatment options for arthritis: 1) The incorporation of genes encoding these proteins into the joint can supply a constant source of therapeutic proteins or bioactive peptides in the joint; 2) By counteracting the early inflammatory mediators of arthritis, gene therapy can be a potential cure for arthritis. Previously we have demonstrated that myoblast mediated gene transfer to the knee joint is capable of expressing transgenes (ß-galactosidase) for more than 30 days.

In this study we used muscle derived cells (MDC) for an ex vivo gene therapeutic approach to deliver Interleukin- 1 receptor antagonist protein (IRAP) in a rabbit knee joint arthritis model.

We detected higher IRAP levels in the arthritis induced knees than in the control knees.

The IRAP expression decreased the glycosaminoglycan release, indicating the cartilage matrix breakdown. Furthermore, we observed higher levels of newly synthesized proteoglycans in the treated group at 7 and 14 days after injection of the MDC.

This study demonstrates that ex vivo gene therapy using muscle derived cells is feasible for delivering transgene anti-inflammatory proteins such as IRAP to the joint.

Advantages of isolating cells from skeletal muscle include availability, abundance, and surgical accessibility under local anesthesia and, or an office setting. Future research will include characterization of progenitor cells from muscle tissue which, when injected into the joint, can participate itself in the healing process.

81. POSTERIOR ANKLE ARTHROSCOPY: AN ANATOMIC STUDY. ***David Sitler, MD**; Annunziato Amendola, MD; Christopher Bailey, MD; Lisa Thani, MD*

OBJECTIVE: The purpose of this study was to evaluate the relative safety and efficacy of posterior ankle arthroscopy using posteromedial and lateral portals with the ankle in a prone position.

METHOD: 13 fresh frozen, cadaver specimens were secured with the foot prone. A posterolateral portal was established adjacent to the Achilles tendon at the posterior tibio-talar joint level. A 2.7 mm 30° arthroscope was utilized. A posteromedial portal was established under direct visualization. The ankle joint, medial and lateral gutters, the subtalar dome and the flexor hallucis longus tendon (FHL), were visualized. The talar dome was marked with electrocautery. Distances from cannula to sural nerve, lesser saphenous vein, posterior tibial nerve and artery, FHL, and calcaneal nerve were measured using MR imaging and dissection. The amount of talar dome visualized was also measured

RESULTS: Mean distances in millimeters from cannula:

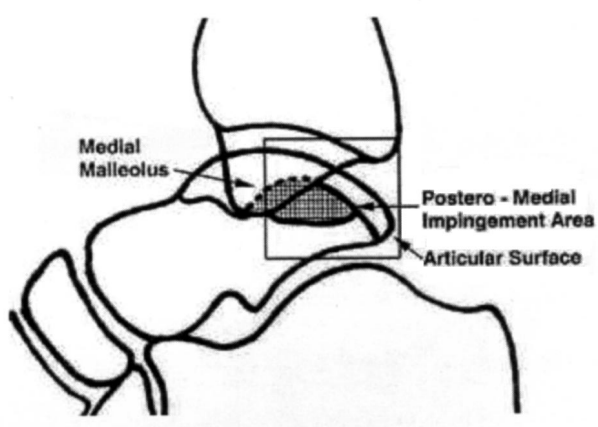
	Sural Nerve	Lesser Saphenous Vein	Posterior Tibial Nerve	Posterior Tibial Artery	Calcaneal Nerve	Flexor Hallucis Longus
DISSECTION	3.2 (0-8.9)	4.8 (0-11)	6.4 (0-16)	9.7(2-20)	17 (0-31)	2.7 (0-11)
MRI	2.7 (0- 9)	4.6 (0- 10)	*	*	*	2.2 (0-9)

* The calcaneal nerve and individual neurovascular bundle structures could not be identified by MRI, however the distance from cannula to the posterior neurovascular bundle was 3.5 mm. The mean segment of the talar dome seen was 54% (42% - 73%). No injury to any neurovascular structure was evident in any specimen.

CONCLUSIONS and SIGNIFICANCE: The posteromedial portal with the ankle prone is safer than previously reported, but caution must be exercised. Access to the posterior half of the talus and posterior ankle structures was well demonstrated. This technique allows safer posterior access and the treatment of pathology not easily addressed by the standard supine anterior approach.

82. THE POSTEROMEDIAL IMPINGEMENT (PoMI) LESION OF THE ANKLE. ***Roger S. Paterson, FRACS**; Jeremy N. Brown, FRCS; Simon J. Roberts, FRCS*

INTRODUCTION: We report the posteromedial impingement (PoMI) lesion of the ankle. This lesion occurs, on occasion, after a severe ankle inversion injury in which the deep posterior fibres of the medial deltoid ligament become crushed between the medial wall of the talus and the medial malleolus. Initially posteromedial symptoms do not predominate compared with the symptoms of the lateral ligament disruption, and usually resolve without specific treatment. Occasionally however, thick disorganised fibrotic tissue persists and impinges between the medial wall of the talus and the posterior margin of the medial malleolus. (Figure 1)



It is often difficult to separate symptoms associated with chondral damage, an ossicle at the tip of the medial malleolus, or synovial impingement but the PoMl lesion has a distinct pathological picture. The PoMI lesion usually co-exists with other ankle lesions which have been previously cited as causes of ongoing pain after lateral ligament injury.

METHODS: Six patients have been seen with an isolated PoMI lesion over a three-year period. The clinical presentation is of persistent medial to posteromedial activity-related ankle pain after a severe inversion injury despite a sound ankle rehabilitation program. There is deep soft tissue induration immediately behind the medial malleolus with localised tenderness and reproduction of symptomatic pain on

provocative testing by palpating while moving the ankle into plantar flexion and inversion.

In order to establish the clinical significance of this lesion and the effectiveness of treatment, the findings and outcomes are reported for all six patients seen in a three-year period who have undergone surgery for an isolated PoMl lesion, diagnosed clinically and often with additional isotope bone scanning, in whom examination under anaesthetic and arthroscopy have demonstrated no ligament laxity nor chondral damage.

RESULTS: Histological analysis of tissue removed at surgical excision differentiates this disorganised fibrosis from synovial impingement. The results of surgery were excellent with all six patients being able to return to their preinjury level of activity.

CONCLUSION: The PoMI lesion can be a significant cause of morbidity after a severe inversion injury of the ankle, but has not been widely recognised. Diagnosis can be confirmed by bone scan and/or MRI, after being suspected on clinical examination. It is recommended that this cause of pain not be overlooked in treating refractory symptoms following an ankle sprain.

83. ARTHROSCOPIC TREATMENT OF THE ANKLE IMPINGEMENT SYNDROME IN HIGH LEVEL SPORTS.

***Alberto Pienovi, MD**; Luciano Quevedo, MD; Sergio Masetti, MD; Pablo Segura, MD*

Objective: This prospective study evaluates the results of the arthroscopic treatment of the ankle impingement syndrome. The group included highly active young athletes. A hundred and seven patients presenting ankle impingement syndrome were studied.

Method: From the group studied, 83 were men (77.5%) and 19 women (17.7%) with an average age of 25.2 (from 18 to 35) The average follow-up was 52 months (12 months to 8 years). The pathology was classified into 4 types, all receiving arthroscopic treatment. In all cases preoperative MRI was performed. Patients were evaluated objectively and subjectively, and sports activity was especially considered in the results. The surgical technique was described.

Results: Results were excellent or very good in 92 patients (85.98%), fair in 11 patients (10.28%) and poor in 4 patients (3.74%). Ninety-one percent of the patients were pleased with the method used and the results obtained. Eighty-one patients (75.7%) returned to their previous level of activity in sports. This result declined in time.

Conclusions: Ankle impingement syndrome is a frequent pathology in contact and high level sports. The arthroscopic treatment is an effective procedure and the results are acceptable, but they decline with time in long-term evaluations.

84. ARTHROSCOPIC TREATMENT OF SUB-ACUTE AND CHRONIC SYNDESMOSIS INJURIES OF THE ANKLE.

***James P. Tasto, MD** (a, b – Bionx); Peter Laimins, MD*

Objective: Unrecognized sub-acute and chronic syndesmosis injuries of the ankle with residual diastasis are a difficult management problem in orthopedics. There are very few operative procedures described in the literature to correct this problem, and residual disability is rather significant. An arthroscopic procedure was designed to restore stability, correct the diastasis, and return the patient to a better functional state.

Methods: Nine patients were entered into the study over a four-year period; all patients have had a minimum of six months follow-up. One of the nine had an associated fibular fracture; all patients had subtle or overt x-ray evidence of syndesmosis disruption and diastasis, some requiring stress x-rays for verification. Patients underwent an arthroscopic debridement of the interosseous component of the syndesmosis to create a fibro-osseous bed and subsequent stabilization with the single syndesmosis screw. Eight of the nine patients underwent a repeat arthroscopy at the time of syndesmosis screw removal.

Results: Eight of the nine patients had healed radiographically and clinically; one of nine patients failed, but did not adhere to the protocol. He was a diabetic with a peripheral neuropathy and probably developed a Charcot joint. Eight of nine had confirmed healing by repeat arthroscopy and stress fluoroscopy. Eight of nine patients returned to full activity and sports. Average follow-up time was 11.3 months (R = 6-22 months).

Conclusion and Significance: The success rate for those that followed the post-operative protocol was 100% (8 of 8 patients). The one failure was a diabetic patient who began early weight bearing, had no pain and subsequently developed what appeared to be a Charcot joint. The procedure was verified with stress radiography and a repeat diagnostic arthroscopy, which showed complete union of the syndesmosis. This procedure has been done for 4 years with a minimum 6-month follow-up, and results are encouraging with a complete restoration of radiographic integrity and a full return to sports and normal activities in those patients following the protocol.

85. LONG-TERM EFFECTS OF ANKLE JOINT SUPPORT ON SENSOMOTOR AND SPORT-SPECIFIC CAPABILITIES.

***Joerg Jerosch**; Ralf Schoppe*

Purpose: The purpose of the present study was to evaluate the influence of sensomotor characteristics, sport-specific capabilities, subjective quality of living and subjective feeling by fitting an elastic ankle joint support in the short term and long term.

Material & Methods: 21 subjects with functional ankle instabilities were provided with an ankle support for all athletic and other physical activities over a period of 3 months. At defined points in time [at the beginning (T0), after 3 weeks (T1), after 6 weeks (T2) and after 3 months (T3)] standardised tests were performed. The following evaluation methods were applied: KAT-2000 (static and dynamic), sidesteps over 8 metres, isokinetic force (Cybex 6000), angle reproduction test, SF-36 Score, and Weber ankle score.

Results: The results indicate that the support used improves both sensor motor capabilities and sport-specific capabilities. This particularly also applies to dynamic requirements as in the dynamic KAT 2000 Test. At the same time, the test subjects using the supports with functional ankle-joint instability also demonstrated improved sport-specific capabilities such as are required in the fast side-step run. No negative effect on sport-specific skills or isokinetic strength was documented over time, even after 3 months. The same applies to mobility in the talo-crural joint and to speed in the side-step run.

Conclusion: This study demonstrates that even over a period of 3 months there are no detrimental effects on sport-specific skills.

87. IS THE SAGITTAL SLOPE OF THE TIBIAL PLATEAU INFLUENCED BY OPEN WEDGE HIGH TIBIAL OSTEOTOMY IN THE UNSTABLE KNEES?

***C.B. Marti**; S.W. Wachtl; E. Gautier; R.P. Jakob*

Introduction: The results of medial opening wedge osteotomy depend on the accuracy of preoperative planning, the degree of correction and the quality of fixation. The purpose of our study was to evaluate whether a frontal plane correction influences the sagittal slope of the proximal tibia and to determine the influence of the tibial slope on the anteroposterior stability of the knee.

Method: 24 patients with the mean age of 35 years had anteroposterior knee instability and were available for a follow-up evaluation at a minimum interval of 8 months postoperative (mean 23 months, range

8-40 months). 18 patients had an anterior instability (group I), 6 patients a posterior instability (group II). In group I, 14 patients had a prior ACL reconstruction, 5 patients underwent a combined valgus osteotomy and ACL reconstruction (3 reoperations). In group II, 5 patients underwent a prior PCL reconstruction and 2 patient a combined valgus osteotomy and PCL reconstruction (2 reoperations).

Results: In group I, the mean anterior translation didn't change after open wedge high tibial osteotomy and was 10 mm pre- and postoperative. The tibial slope increased by 4.5° (from 7° to 11.5°). In group II, the mean posterior instability decreased by 3 mm (from 15 to 12 mm). The mean tibial slope increased on purpose by 5.8° (from 6.4° to 12.2°).

Conclusion: A medial opening wedge osteotomy not only alters frontal plane axis but affects the posterior slope of the tibial plateau in the sagittal plane as well. We have observed that the posterior slope increases performing a opening wedge proximal tibial osteotomy. We confirmed the findings of Bonnin that this flexion effect on the tibial plateau is unfavorable in anterior knee instability because it increases anterior translation of the tibia, but can be favorable in posterior instability with reducing the posterior sag.

Bonnin M. La subluxation tibiale antérieure en appui monopodal dans les ruptures du ligament croisé antérieure; étude clinique et biomechanique. Thèse Medecin no. 180, Lyon (1990).

Dejour H., Neyret P., Bonnin M. Monopodal weight-bearing radiography of the chronical unstable knee. The knee and the cruciate ligaments. Springer Verlag (1990), 568-576.

88. OSTEOTOMY FOR KNEE INSTABILITY: THE EFFECT OF INCREASING TIBIAL SLOPE ON ANTERIOR TIBIAL TRANSLATION. ***Annunziato Amendola, MD****; Robert Griffin, MD; David Sanders, MD; Jason Hirst, B.Sc.; J. Johnson, PhD*

OBJECTIVE: The purpose of this study was to quantify the effects of an increase in tibial slope on tibial start position and anterior tibial translation in both anterior cruciate ligament (ACL) intact and deficient knees.

METHODS: 6 fresh-frozen cadaveric knee specimens with no ligamentous injury were cut 20 cm from the joint line. Peri-articular soft tissues were preserved. Isolated quadriceps and hamstring tendons were sutured to computer actuated cables. Specimens were mounted on a knee-testing apparatus allowing 5° of freedom. An electromagnetic tracking device measured tibial translation and rotation relative to femur. Loading protocols used were: static loading at 0, 30, 60 and 90° flexion; Lachman test (100N); passive motion with continuous muscle loading. Each was repeated using quadriceps (200N), hamstrings (80N), and combined quadriceps / hamstrings load, and randomly applied to ACL intact and transected non-ostetomized specimens, and to ACL intact and transected specimens with anterior opening wedge 5 and 10 mm osteotomies. Analysis of the effects of tibial slope, muscle loading, and flexion angle on knee kinematics under the above conditions was with repeated measures ANOVA.

RESULTS: Anterior tibial translation is the sum of the tibial start position and anterior tibial displacement under load. The tibial start position in the ACL intact knee moved 4 mm and 9.5 mm anteriorly in the 5 and 10 mm osteotomies respectively ($p>0.001$). There was no difference in tibial start position in ACL intact compared to ACL cut conditions ($p>0.05$). ACL sectioning increased anterior tibial motion ($p<0.001$). The increase in tibial slope with 5 and 10 mm osteotomies decreased anterior tibial motion ($p<0.05$). Anterior tibial translation decreased during hamstring versus quadriceps loading for all testing conditions ($p<0.001$).

CONCLUSION and SIGNIFICANCE: Increases in tibial slope created by opening wedge osteotomy significantly increase anterior tibial start position relative to femur. Tibial slope alteration should be considered with high tibial osteotomy, particularly in the unstable knee, to improve sagittal knee stability.

89. HIGH TIBIAL OSTEOTOMY: A 10 TO 21 YEAR FOLLOW-UP STUDY. ***Roberto Buzzi, MD****; Paolo Aglietti, MD; Luca Maria Vena, MD; Andrea Baldini, MD*

Objective: To review our long-term experience with high tibial valgus osteotomy (HTO) and to determine which factors may influence the results.

Methods: From 1979 to 1990, 121 closing wedge HTOs for varus gonarthrosis were performed by a single surgeon in 105 patients. Thirty knees were not included because the patients had died (18 knees), were bedridden (7 knees) or lost to follow-up (5 knees). Survivorship analysis was performed on the remaining 91 knees. Twenty-nine of these 91 had a conversion to total knee arthroplasty after 11 years on average, leaving 62 knees with an HTO available for clinical and radiological evaluation at an average FU of 14 years (range: 10-21 yrs).

Results: The 62 knees still with an HTO had excellent-good results in 64% and fair-poor in 36% both in Knee and Function Score. Anatomical femoro-tibial angle at FU averaged $4.7\pm5°$ (range: 3° varus to 23° valgus). Change in alignment at FU with varus recurrence was observed in 26 (42%) reviewed knees and did not correlate with clinical results. Posterior tibial slope (sagittal plane) decreased at FU from 5.4° to 1.6° on average. Fourteen knees (23%) showed a patella baja (Insall-Salvati ratio <0.8) at FU. A valgus alignment at consolidation between 9° and 12°, a BMI <28 and male gender correlated with satisfactory results ($p<0.05$). Survivorship analysis, considering unsatisfactory results or revision to TKR as the end point, was 71% (C.I. $=63$-79%) at 10 years.

Conclusions: HTO for varus gonarthrosis can be effective for a long period. After 10-15 years deterioration of the results can be expected. HTO is unlikely to give permanent relief but may buy time.

90. PROGRESSION OF BONE SPUR FORMATION AFTER HIGH TIBIAL OSTEOTOMY FOR THE OSTEOARTHRITIS OF THE KNEE. FIVE TO THIRTEEN YEARS PROSPECTIVE STUDY. ***Jun Kitahara, MD****; Shaw Akizuki, MD, PhD; Tsutomu Takizawa, MD, PhD; Yukihiro Yasukawa, MD, PhD*

PURPOSE: To evaluate the osteoarthritic change after high tibial osteotomy (HTO) of the knee and its clinical outcome.

METHOD: We studied 160 knees of 134 patients with medial compartment osteoarthritis of the knee, which were operated HTO in 1986 for 1995, and also studied the relationship between osteoarthritic change and clinical outcome of HTO. The mean age of the patients was 64 years (range, 45-77 years). The mean follow-up period is 8.1 years (range, 5.0-13.3 years). Osteoarthritic change was evaluated by the bone spur formation. We measured bone spur of medial condyles and lateral condyles of femur and tibia, and patellofemoral joint. We acculated the progress of spur formation as follows: no bone spur pre- and postoperatively is 0 point, bone spur had already existed and no progress postoperatively: 1 point, bone spur has grown postoperatively: 2 points. Clinical evaluation was performed using the Hospital for Special Surgery (HSS) knee score. Paired t-test and ANOVA were used for the statistical analysis.

RESULTS: The point of bone spur formation was 4.0 points preoperatively, but it progressed to 7.5 points postoperatively. HSS score was significantly improved from 48.7 points preoperatively to 80.4 points. Almost all cases bone spur have progressed postoperatively, and the higher the point of bone spur preoperatively, the larger bone spurs have grown postoperatively. There was negative correlation between

clinical outcomes and the points of bone spur ($r=-0.27$, $p<0.005$). The femorotibial angle (FTA) was improved postoperatively, but there was no correlation between FTA and the growth of bone spur ($r=0.05$, $p=0.58$).

CONCLUSION: As change of mechanical axis by HTO, clinical outcome was improved significantly, but it couldn't prevent the progress of osteoarthritic change as spur formation.

91. INSTRUMENTED VERSUS NON-INSTRUMENTED UNICONDYLAR KNEE PROSTHESIS. 5-YEAR FOLLOW-UP.

Jean-Yves Jenny, MD *(a – Aesculap AG, Tuttlingen); Cyril Boeri, MD*

PURPOSE: Most unicondylar prostheses are resurfacing ones without precise instrumentation. However the quality of implantation is an accepted prognostic factor for long-term outcome. The authors compared the clinical and radiological outcomes of two matched-paired groups of patients operated on with either resurfacing prosthesis without instrumentation or prosthesis with femoral geometrical resections and sophisticated instrumentation similar to total knees.

METHODS: 104 patients out of 400 consecutively operated by two different unicondylar knee prostheses for primary medial gonarthrosis were matched for age, gender, body mass index and severity of preoperative degenerative changes according to Ahlback. 52 resurfacing prostheses without instrumentation (group I) and 52 prostheses with sophisticated instrumentation and geometrical femoral resections (group II) were studied. Patients were prospectively followed up. Clinical and radiological outcomes were studied according to the Knee Society Scoring System, and revision rates after 5 years were compared in both groups with a Logrank test.

RESULTS: Mean follow-up was 5 years (4 to 7 years). There was no significant difference in the clinical outcome between both groups. Revision rates were similar : 6% in group I, 5% in group II. There was a significant better quality of implantation measured on postoperative X-rays for instrumented prostheses.

CONCLUSION: Instrumented unicondylar knee prostheses allow a higher quality of implantation in comparison to resurfacing prostheses. However, with 5-year follow-up, no difference in clinical or radiological outcomes could be observed.

92. UNICOMPARTMENTAL ARTHROPLASTY FOR GONARTHROSIS TREATMENT.

Claudio Zara*; Stefano Albanelli; Antonio Pelati*

Objective: Our aim was to show the indications on the use of the Unicompartmental Arthroplasty and bring our results with a follow-up of 4 years.

Methods: From 01.05.96 up to 31.05.00 142 unicompartmental prostheses were implanted, 16 of which were bilateral. The age of patients was between 55 and 81 years. The prosthesis we used is "Allegretto." The primitive diagnosis was: 112 gonarthrosis, 15 osteonecrosis, 7 post traumatic and 8 post meniscectomy. On all patients an articular radiographic study was carried out. The preoperative clinical evaluation, the intraoperative and that one of the follow-up were standardized according to the Knee Score Society.

Our strict selection criteria were (1) the presence of a functioning anterior cruciate ligament, (2) fully correctable deformity, (3) full thickness of articular cartilage on the other two knee compartments, and (4) when the corrective osteotomy is not possible.

Results: We have obtained an average preoperative score = 83.7 and average postoperative score = 154.3 with an increase of 70.6. The highest value was obtained with the pain and motility; patients' opinion was generally satisfied or excellent.

Conclusions: Our experience brought us to consider the Unicompartmental Prosthesis as an indispensable surgical means based on the following considerations: - is less invasive than TKA, - the surgery is well tolerated by the patient, - the morbidity is low, - blood transfusion is not necessary, - gives better range of movement and more physiological functions. Nevertheless is a prosthetic implant with the risk of infection or aseptic loosening.

93. UNICOMPARTMENTAL PROSTHETIC REPLACEMENT VERSUS HIGH TIBIAL OSTEOTOMY IN MODERATE MEDIAL KNEE OSTEOARTHROSIS.

Lars Weidenhielm, Asst. Prof.*; Margareta Börjesson, R.P.T.; Lars-Åke Broström, Prof.; Eva Mattsson, Asst. Prof.*

PURPOSE: In this prospective randomised study, the clinical results after unicompartmental prosthetic replacement or high tibial osteotomy were compared. The patients were 55 to 70 years old, with moderate medial knee osteoarthrosis, and their results were compared with a five year follow-up.

MATERIAL: The unicompartmental prosthetic replacement (UKA) group consisted of 50 patients. Five knees were revised. Two patients had died of causes unrelated to the prosthetic replacement and one patient was lost to follow-up examination. This left 42 patients with a mean age 64 years, for examination. At the five-year review wear of the tibial component was seen in 9 cases. A tibial component with a minimum thickness of two mm polyethylene was used in all these cases. The high tibial osteotomy (HTO) group consisted of 50 patients. Four patients had died of causes unrelated to the high tibial osteotomy. Four patients had been revised with prosthetic replacement because of persistent knee pain. This left 42 patients with a mean age 63 years for examination at the time of five-year follow-up.

RESULTS: In the UKA group the mean modified BOA-score (maximum 39 points) was 30 points before surgery, increased to 37 points one year after surgery and was 36 five years after surgery compared to 30, 38 and 37 points respectively in the HTO group. At the five-year review, the mean HSS-score was 91 in the UKA group compared to 93 in the HTO group and mean VAS for pain during walking was 15 mm compared to 12 mm in the HTO-group. There was no difference in the patients' own opinion of the result between the groups. In this prospective randomised study both groups improved equally five years after surgery.

CONCLUSION: We did not find any major benefit of one treatment over the other at the five–year review. However, with the high rate of pending revisions due to prosthetic wear, better results can be expected with time in the high tibial osteotomy group in this study. Prosthetic wear problems makes high tibial osteotomy a viable alternative in this age group.

94. THE FUNCTIONAL OUTCOME AND SURVIVORSHIP OF MEDIAL COMPARTMENT UNICONDYLAR ARTHROPLASTY OF THE KNEE.

James Bidwell, FRCS Ed.(Tr.&Orth.)*; Piero Gianfreda, MD; Richard Nutton, FRCS*

This study is a retrospective review of the survival and outcome of medial compartment unicondylar arthroplasty of the knee.

We have reviewed retrospectively the survival of 87 medial compartment unicondylar arthroplasties performed in this unit between 1988 and 1999. The median follow-up was 8 years and patients were reassessed independently at a special clinic to ascertain both the function and survivorship of the retained implants. Two types of unicondylar arthroplasty were used during this period, the Oxford and the PCA.

The total cumulative survival at 8 years for both implants is 80%, but the PCA system showed a very high early failure rate. The Oxford system achieved a survivorship of 92%. Implant survival was defined as time to revision. Implants at risk were also identified by quantifying loosening and polyethylene wear.

Knee function was assessed using the American Knee Society Score, and showed good to excellent function in 80% of reviewed patients, comparing favourably with similar studies in total knee arthroplasty.

Whilst this retrospective study has limitations with its design, it demonstrates that the Oxford unicondylar arthroplasty has performed well when compared with total knee arthroplasty. The PCA arthroplasty demonstrated a high early failure rate, and the reasons for this are discussed.

95. IS THE MORPHOLOGY OF THE MEDIAL FEMORAL CONDYLE ASSOCIATED WITH PRESENCE OF A MEDIAL SYNOVIAL PLICA? ***Jeff Brand****; David N.M. Caborn; Darren L. Johnson*

INTRODUCTION: Are morphologic features of the medial femoral condyle (MFC), which articulate with the medial synovial plica (MSP) indicative of a large and thickened plica? This study evaluated the association between MFC morphology and size and character of the MSP.

METHODS: Thirty-five cadaver knees, mean age 66.5 (53-81), were dissected. The MSP was measured in millimeters (mm) at its widest point and characterized as none 10/25, thin 20/35 and thickened 5/35. The articular cartilage was characterized as normal 14/35, flattened 17/35, and indented with cartilage loss in the remaining 4 femurs. The medial aspect of the MFC was noted to have a notch in 27 of 35 and the other 8 had no notch of the MFC. Sunrise radiographic views were developed of 18 femurs, 13 of 18 had no indentation of the MFC adjacent to the patellar articular surface and 4 of 18 did have an indentation or notch adjacent to the articular surface.

RESULTS: By logistic regression, a thickened MSP was not correlated with the examined features of the MFC; including a notch of the MFC ($p=0.94$), articular cartilage change ($p=0.24$) nor a radiographic notch ($p=0.13$). Plica size in mm was slightly more positively correlated; MFC notching ($p=0.52$), articular cartilage change ($p=0.10$) and radiographic notching ($p=0.09$). None of these relationships were significant at $p<0.05$.

DISCUSSION: A notch of the MFC or articular cartilages change did not agree well with the size and character of the MSP. These factors could not be used, based on this study, in the decision for excision of symptomatic MSP.

96. MODIFIED TECHNIQUE TO THE PROXIMAL REALIGNMENT IN THE PATELLOFEMORAL INSTABILITY – RESULTS ANALYSIS. ***Sergio Mainine, MD****; F.F.F. Fonseca, PhD; P.C.Z. Faria, MD; P.C. Barone, MD*

PURPOSE: Assess the results of surgical treatment of patellofemoral instability using a modified technique of proximal realignment and explain the modification in detail.

METHOD: A thorough review of the cases of 57 patients, 58 knees was performed, with postoperatory observation time varying from 1 to 5.5 years, and average time of 2.5 years. The patients' age varied from 8 to 52 at the time of surgery, with average age of 25 and modal average 18.

There were 4 (6.9%) cases of acute patellar dislocation and 54 cases of (93.1%) chronic patellofemoral instability. The diagnosis was based on the clinic history and confirmed by physical findings. Patients were examined under anesthesia immediately before the surgical action, showing: 43 (74.2%) recurrent patellar dislocation, 9 (15.5%) recurrent subluxation of the patella, 4 (6.9%) acute patellar dislocation, 1 (1.7%) habitual dislocation of patella and 1 (1.7%) habitual patellar subluxation.

The proximal realignment using the modified technique, which is achieved by moving the vastus medialis obliquus muscle together with its retinaculum over across the patella and reinserting it using transbone stitches, was used on the 58 knees (100%). Medialization of the tibial tuberosity was associated in 49 (84.5%) cases and liberation of lateral retinaculum in 41 (70.7%) cases. Post-operatory immobilization was performed in 34 (58.6%) cases; 24 (41.4%) cases received no immobilization.

RESULTS: The results were assessed by Turba's et al. criteria, using the recurrence of subluxation and dislocation of the patella index to compare our results with those of other authors who have used other methods of assessment. In our subjective evaluation 32.8% were excellent, 3.4% good, 8.6% fair and 5.2% poor. On the objective evaluation, 36.2% of the results were excellent, 48.3% good, 15.5% fair and no poor results were observed. The treatment was effective to minimize the giving way episodes and it turned the apprehension test negative. The following factors had no influence whatsoever on the results: the amount of time of clinic history at the preoperative period, the association or not of the distal realignment, the lateral retinaculum release performed or not, the presence of chondral lesions or knee immobilization after surgery. The subjective results were better than those of Turba's et al. The subjective results were better than Turba's et al. The recurrence index (3.4%) was one of the lowest found in the literature referred to. The complication index (8.6%) was considered low.

CONCLUSION: The described technique was effective to treat the patellofemoral instabilities; the results shown were similar or better than those in the literature findings even with no immobilization after surgery.

97. OUTCOME OF COMBINED PROXIMAL/DISTAL REALIGNMENT FOR PATELLOFEMORAL INSTABILITY IN ATHLETES. ***Thomas S. Muzzonigro, MD****; Christopher D. Harner, MD*

Intro: This study was designed to assess the outcome of a combined proximal (soft-tissue) and distal (bony) realignment procedure for patellofemoral instability in an athletic subpopulation.

Methods: Between 1990 and 1998, twenty-nine athletes underwent patellofemoral realignment for recurrent patellar instability after failing conservative measures and inability to participate in sports. All patients followed a standard post-op protocol for three months. This group of athletes represents a subpopulation of 97 patients who were evaluated and treated for recurrent patellar instability that failed conservative treatment. 54 patients were treated with the combined surgical procedure, of which twenty-nine competed in organized sport. Outcome was measured using the lKDC form, the Activities of Daily Living (ADL) and Sports Activity Scale (SAS) of the Knee Outcome Survey at a minimum of two years follow-up.

Results: 24 of 29 (83%) athletes returned the questionnaires, and 22 of 29 (76%) returned for a detailed physical exam. The mean age of the patients was 23.9 years (range 16-43). 18 patients had unilateral symptoms and 6 had bilateral. Pre-operatively all patients reported instability that restricted their participation in sports. Postoperatively 89% reported no further episodes of instability. 86% described sports function and 82% described sports activity as normal or nearly normal. 86% stated they were greatly improved and 9% stated they were somewhat

better and no patients were worse. The results of the one-legged hop, one-legged jump, and isometric quad tests (expressed as a percentage of the contralateral side) were 95%, 94%, and 99% respectively for the 18 patients with unilateral instability. Athletes returned to sports between 3 and 6 months after surgery. There were no significant postoperative complications.

Discussion: Combined proximal/distal patellar realignment is a reasonable surgical approach to patellofemoral instability in athletes who fail conservative measures. The procedure is reproducible, reduces episodes of instability and pain, and allows return to competitive sports.

98. RECONSTRUCTION OF THE MEDIAL PATELLOFEMORAL LIGAMENT IN RECURRENT DISLOCATION OF THE PATELLA. ***David A. Young****; Graham Hill; Tracy Peters*

OBJECTIVE: To evaluate the long term results of a new surgical procedure for recurrent dislocation of the patella in patients who habitually sublux their patellae in extension. This condition has long been identified as a difficult management problem. We believe the essential lesion is deficiency of the medial patellofemoral ligament requiring a strong reconstruction for long-term good results.

METHODS: Between 1991 and 1998 a consecutive group of 43 patients with 52 knees were followed prospectively after reconstruction of the medial patellofemoral ligament using semitendinosis tendon. The patients were assessed independently with a minimum of 2 years post-surgery using Kajula and Lyshlom scores, Tegner activity score as well as clinical and radiological assessment.

RESULTS: Duration of instability varied from 1-39 years. 19 patients had had one or more previous realignment procedures. Only 15 knees had reconstruction alone the rest requiring chondral debridement of the patella. Pre-operative radiographs and dynamic CT scans were all abnormal. Only one patient developed further subluxation symptoms. No frank dislocations occurred. Using the Kujala score 31 knees were good to excellent, 11 fair and 10 poor. The fair and poor results were all due to severe retropatellar chondropathology. Only three patients with four knees felt their pain was worse following surgery. We could identify only two complications following surgery, a neuropraxia of the saphenous nerve and one postoperative staphylococcal infection. Tegner scores demonstrated a significant return to preinjury sporting activities for the whole group.

CONCLUSIONS: Our results show that a modification of the original Galeazzi semitendinosis transfer for patellar instability has proved to be a very successful operation. It involves reconstruction of the medial patellofemoral ligament with the end of the transferred semitendinosis.

99. EXTERNAL TIBIAL TORSION. AN UNDER-RECOGNIZED CAUSE OF RECURRENT PATELLAR DISLOCATION. ***John C. Cameron***

Seventeen patients (18 knees) with recurrent patellar dislocation were identified with increased quadriceps angles secondary to excessive isolated external tibial torsion. Traditional re-alignment procedures attempted in these knees were unsuccessful because of failure to align the biomechanical axis of the extensor mechanism. Derotational osteotomies of the tibia just proximal to the patella tendon insertion were used to reduce the quadriceps angle to within normal limits to improve the biomechanics of the extensor mechanism. Seventeen (94%) knees were available for clinical and subjective follow-up at an average 5 years (range 4-6 years). Overall, 13 of the 17 knees were graded as good to excellent (76%). Five of the 17 patients also had well established anterior knee pain in addition to recurrent dislocation and were treated with a combined derotational and Maquet type osteotomy, with 4 patients obtaining a good to excellent result. Knees that subjectively and functionally demonstrated less painful symptoms preoperatively were associated with excellent results. Poor outcomes were associated with knees that were operated on multiple times. In patients with external tibial torsion 45° or greater, derotation osteotomy should be utilized to reduce the 'Q' angle.

100. INTRINSIC RISK FACTORS FOR THE DEVELOPMENT OF PATELLAR TENDINITIS IN AN ATHLETIC POPULATION: A 2-YEAR PROSPECTIVE STUDY. ***Erik Witvrouw, PT, PhD****; R. Lysens, MD, PhD; J. Bellemans, MD, PhD; R. Verdonk, MD, PhD*

PURPOSE: Many variables have retrospectively been associated with the presence of patellar tendinitis. Very few prospective data however exist to determine which of these variables will lead to the development of patellar tendinitis. It was the purpose of this study to determine the intrinsic risk factors for the development of patellar tendinitis in an athletic population over a 2-year period.

METHOD: 138 male and female students in Physical Education with a minimal sports activity of 12 hrs./week were followed in a two-year prospective study. Before the start of their education, all students were evaluated on anthropometric variables, lower leg alignment characteristics, and muscle length and strength parameters. All students with previous knee complaints were excluded from this study.

RESULTS: During this two-year follow-up study 19 of the 138 students developed patellar tendinitis. In all cases the diagnosis was confirmed by the presence of an hypoechogenic nodular lesion in the proximal region of the patellar tendon. Stepwise discriminant function analyses were performed on the various measurements. These analyses determined only a shortened M.quadriceps and M.hamstrings as significant risk factors for the development of patellar tendinitis ($P<0.05$).

CONCLUSION: In this prospective study only a shortened M.quadriceps and M.hamstrings could be determined as significant intrinsic risk factors for the development of patellar tendinitis.

SIGNIFICANCE: The prevention of this condition in athletes should therefore be focused on the screening and treatment of the decreased M.quadriceps and M.hamstrings flexibility.

101. ARTHROSCOPIC TREATMENT OF DISPLACED PATELLAR FRACTURES. *Arturo Makino, MD; Miguel Puigdevall, MD; Esteban Garces, MD;* ***Luis Aponte-Tinao, MD****; D. Luis Muscolo, MD; Matias Costa-Paz, MD*

OBJECTIVE: The purpose of this paper was to report the results of an arthroscopic internal fixation of displaced transverse patellar fractures using a tensioned anterior wire placed within a pair of cannulated compression screws.

METHODS: We applied this technique in five patients who presented a displaced transverse patellar fracture that were followed for an average of eighteen months. Under image-intensifier fluoroscope the fracture was closely reduced with a percutaneously applied clamp while the congruence of the articular surface was controlled arthroscopically. Two Kirschner wires were inserted perpendicular to the fracture line followed by two cannulated lag screws obtaining interfragmentary compression. Using a cannulated guide two wires were threaded through both cannulated screws and percutaneously were crossed over the top of the patella creating a figure-of-eight pattern tension band.

RESULTS: At final follow-up, radiographic consolidation was achieved in all patients obtaining full range of motion and returning to the same activity level they had before.

CONCLUSION: Arthroscopic internal fixation is a valid alternative for the treatment of intra-articular displaced and no comminuted patellar fractures. This technique allows healing of the fracture with low patient morbidity, a short hospitalization period and an accelerated rehabilitation of the affected knee.

102. FREQUENCY OF ANTERIOR KNEE PAIN AFTER ACL-RECONSTRUCTION WITH PTBTB GRAFT – A PROSPECTIVE INVESTIGATION. ***Suzanne Werner, Dr. Med Sc.****; Christina Mikkelsen, RPT; Kam San Tho, MD; Anders Valentin, MD; Ejnar Eriksson, MD, PhD*

Aim of study: Many previous studies report an incidence of 17%-50% of patellofemoral pain (PFP) after PT ACL reconstructions. All studies are retrospective, however. How can these authors publish their papers, when they do not know how much PFP the patients had before surgery? This is the first ever study that is prospective and uses a carefully tested PFP score. Furthermore, we wanted to study if there exists a difference in frequency of PFP after ACL reconstruction with central or medial patellar tendon grafts?

Material & Method: 41 patients scheduled for arthroscopic PT ACL reconstruction answered a PFP score (Werner et al 1993) to check whether PFP existed before and on average 9.9±1.9 months after their ACL reconstructions. This knee score involves different categories typical for PFP patients, i.e., stair climbing, squatting and arretations. Furthermore, the score has a total sum between 0 and 50, where 0 means severe PFP problems and 50 no such problems at all. The reproducibility of this score has been tested in 30 PFP patients answering the knee score at two different occasions within 1-2 weeks. The result showed a reproducibility of $r=0.96$.

Result & Conclusion: 35 out of the 41 ACL reconstructed patients reported less PFP problems 9 months after surgery ($M=41.5\pm8.1$) compared to before surgery ($M=30.3\pm5.9$) ($p<.001$). No significant differences in the amount of PFP between the central and the medial patellar tendon grafts were found. Studies dealing with frequency of PFP should be carried out **prospectively**, since many patients report more PFP before than after ACL reconstruction.

103. THE OPTIMUM ANGLE FOR PATELLA SKYLINE RADIOGRAPHY. ***Simon Owen-Johnstone, FRCS****; Jens Bayer, MRCS; Andy Davies, MRCS; Lee Shepstone, PhD; Simon Donell, FRCS; Tom Marshall, FRCS; Malcolm Glasgow, FRCS*

A prospective, blinded x-ray study to demonstrate the superiority of the 25-degree (minimally flexed) skyline view over views taken at other angles.

Hypothesis: The 25-degree skyline view is superior to other angles; other angles do not contribute any further information and have a significant false negative rate.

Patients: One hundred consecutive new patient referrals to the Orthopaedic department at the Norfolk and Norwich Hospital for investigation of anterior knee pain, aged between twelve and thirty-five years. An additional subgroup of twenty-five patients with patello-femoral instability identified by clinical assessment and CT scan was also studied.

Methods: Each knee received standardised skyline radiographs at 25, 50 and 90 degrees. Three independent observers (two orthopaedic surgeons and a radiologist) who were blinded to the clinical information reported the films according to predefined criteria. Several different described measurements were made. Clinical data was collected from the notes. Intra-observer variability was addressed by repeat reports for a sample of the films.

Results: The pathology detected on the three views was compared and subjected to statistical analysis. This showed that the minimally flexed view provided the greatest yield of clinically useful information. The other views had significantly higher false negative rates. This applied to both the consecutive prospective group and the patellar instability group. Analysis showed that the views at 50 and 90 degrees contributed nothing to the radiological assessment of the knee that could not be obtained from the 25-degree view.

Conclusion: Skyline views provide the greatest amount of information when performed in the minimally flexed position.

104. SURGICAL TREATMENT OF QUADRICEPS FEMORIS TENDON RUPTURES WITH THE DYNAMIC TENDON GRIPPING TECHNIQUE (NEW METHOD). ***Ioannis Valavanis, MD, PhD****; Ioannis Ioannides, MD; Lykourgos Kollintzas, MD; Stratigoula Valavanis, MS*

Objective: Evaluation and presentation of the new Dynamic Tendon Gripping technique as used successfully in the treatment of ruptures of the Quadriceps Femoris tendon.

Introduction: Ruptures of the distal tendon of the quadriceps femoris muscle are difficult to treat since surgery is followed by a long lasting immobilization period and a vigorous rehabilitation program since available suturing techniques do not result in immediate restoration of the extensor mechanism of the knee. Treatment with the new Dynamic Tendon Gripping (DTG) technique results in immediate full weight bearing and full range of motion of the knee with absolutely no need for post operative immobilization, thus minimizing rehabilitation period.

Surgical Technique: The DTG net is formed by a single strong polyester tow interwoven around the proximal stump of the ruptured tendon. Distal pulling of the free ends of the tow produces a gradual increase of the constriction forces applied around the tendon stump. The free ends of the tow are anchored through the patella.

Aftertreatment: A simple elastic dressing is applied around the joint. No splint of any kind is used. Patients are encouraged to full weight bearing and free use of the knee as tolerated, immediately after surgery. Pain usually subsides by the third through the fifth post operative day and vigorous exercises are instituted after skin suture removal.

Material and Results: The new dynamic tendon gripping (DTG) technique has been used for the treatment of five (5) consecutive cases with rupture of the distal tendon of the quadriceps femoris muscle. Sex distribution referred to four male and one female patients, their age ranging from 41 to 65 years. Follow-up ranged from 2 to 9 years (mean: 6.6 years). There were no major complications such as *deep infections* (0%), *deep venous thrombosis* (0%) or *re-ruptures* (0%). Full weight bearing and unrestricted use of the injured limb was possible within the second week post op. Full range of motion (ROM) was restored within the second month after surgery while restoration of muscle strength was fast enough depending upon the individual behavior and consistency of the patients to the suggested rehabilitation regime.

Conclusions: The Dynamic Tendon Gripping technique, as used for the treatment of quadriceps tendon ruptures, is a well tested new method providing excellent immediate as well as lasting clinical results. Patients are able to the fastest rehabilitation regime, compared to other established methods, making it possible for them to participate in sports or labor activities within two months post operatively.

Significance: Dynamic Tendon Gripping technique proved to be a successful method of extreme importance for the treatment of Quadriceps Femori tendon ruptures, overcoming the main disadvantage of post operative immobilization of all the well established treatment

methods. Hopefully it could turn out to be a "method of choice" for the treatment of such ruptures, both recent and neglected.

105. NEGLECTED RUPTURES OF THE PATELLAR TENDON.

***B.R. Tietjens**; M.T. Casey*

PURPOSE: To describe a simple effective method of surgical treatment for neglected ruptures of the patellar tendon.

METHOD: Patients treated had neglected patellar tendon ruptures that were initially misdiagnosed or had failed treatment. Through a midline incision scar tissue was excised and two or three strong cerclage wires were used to approximate the patella and ruptured tendon. The wires were passed from the quadriceps tendon to the tibial tubercle in a figure of eight fashion. The tendon was then reattached with strong non absorbable sutures. No quadricepsplasty was necessary. Following surgery immediate mobilisation was initiated without the use of a brace. The wires were removed six months following surgery.

RESULTS: Four patients were treated on average 29 months following initial injury. Average follow-up was 26 months (13-42 months). Average range of motion was 110 degrees. All patients had unproved quadriceps strength, no extensor lag and had returned to work.

CONCLUSION: Patients with neglected patellar tendon ruptures present with weakness, instability, extensor lag and sometimes pain. Reports in the literature describe autograft and allograft reconstruction and sometimes quadricepsplasty. Post-operative splintage with a cast or brace is often recommended.

We describe a simple effect method of treatment without the use of autograft or allograft. The use of strong cerclage wires allows immediate mobilisation.

106. SECOND LOOK ARTHROSCOPY AFTER ARTHROSCOPIC FIXATION OF OSTEOCHONDRITIS DISSECANS OF THE KNEE.

*D. Luis Muscolo, MD; **Arturo Makino, MD**; Miguel Puigdevall, MD; Miguel Ayerza, MD; Matias Costa-Paz, MD*

OBJECTIVE: To evaluate clinical results and second look arthroscopy findings of osteochondritis dissecans of the knee treated with arthroscopic fixation of the osteochondral fragment.

METHODS: Out of 13 patients with osteochondritis dissecans treated with arthroscopic internal fixation of the osteochondral fragment, 8 patients (9 knees) with a second look arthroscopy were evaluated. According to L. Johnson's arthroscopic classification, seven lesions were grade I and two were grade II. Eight were located at the medial condyle and one at the lateral condyle. All osteochondral fragments were fixed after debridement of the subchondral bone with a 2.3 mm compression Herbert screw. The average age at surgery was 18 years. Outcomes were clinically evaluated at an average follow-up of 33 months by the Lysholm subjective score and by the cartilage standard evaluation form for cartilage knee repair assessment. The second-look arthroscopy was performed at an average of 94 days after surgery in order to remove the Herbert screw and to evaluate the stability of the fragment.

RESULTS: Average postoperative Lysholm score was of 96 points and according to cartilage standard evaluation form, 8 knees showed a normal result and one an abnormal result. At second-look arthroscopy, eight knees showed evidence of a stable fragment, in level with the surrounding cartilage and with an intact smooth surface. In the remaining case approximately 50% of the osteochondral fragment was still attached to the surrounding subchondral bone with a fibrillated articular surface.

CONCLUSIONS: A stable fragment with an intact smooth surface was evident at second look arthroscopy in the majority of patients. In this study, these findings correlates with satisfactory functional results.

107. CALCIUM ALGINATE IN THE TREATMENT OF ARTICULAR CARTILAGE DEFECTS.

Cay Mierisch, MD; *Louis C. Jordan, MD; Gary Balian, MD;* ***David R. Diduch, MD***

Introduction: Alginate has been shown to enhance chondrogenic gene expression in vitro and has been proposed as a carrier for cells and growth factors in vivo. We used alginate to deliver bone marrow stromal cells (BMSC) and TGF-ß to treat osteochondral defects in the rabbit knee.

Methods: Osteochondral defects were created in the trochlear grooves of forty New Zealand White (NZW) rabbits and treated with plain alginate, alginate with BMSCs or with alginate containing TGF-ß at 20 ng/ml or 2 μg/ml. Untreated defects served as control.

Two independent, blinded observers assessed the repairs after six and twelve weeks using a 12-point gross grading scale and a 24-point histological grading scale. Mean scores and standard deviations were calculated. P values were determined with the student's t-test.

Results: Treatment with TGF-ß caused a dose-dependent increase of osteophyte formation, while the quality of the repair tissue was improved at the lower concentration. Treatment with cells and alginate showed the best repair after 12 weeks and reached a mean score of 9.4 on the 12-point scale compared with a score of 8.3 for the control defects ($p=0.02$). Histological analysis confirmed the benefits of alginate. The histological score at six weeks was 16.4 compared with a score of 13.6 by the control ($p=0.007$).

Discussion: Alginate can improve the repair of osteochondral defects in the rabbit. The results after treatment with bone marrow stromal cells were encouraging. TGF-ß at lower concentrations may accelerate the restoration of the joint surface without detrimental side effects. Alginate allows for controlled delivery of growth factors or cells to articular cartilage defects.

108. PREVALENCE OF AHLBACK'S DISEASE IN ELDERLY PATIENTS.

***Dietrich Pape**; Romain Seil; Stefan Rupp; Dieter Kohn*

Introduction: Aseptic osteonecrosis (ON) of the medial femoral condyle has been recently described as a complication of arthroscopic partial meniscectomy. Knowing the prevalence of early stage Ahlback's disease would be helpful to differentiate it from a possible iatrogenic ON following arthroscopy.

Patients and method: Prior to arthroscopy, 176 patients were examined by MRI between 4/98-4/99. All patients met the following criteria: sudden onset of medial knee pain, no history of trauma, clinically suspected meniscal lesion, normal radiographs, age $>$ 50 years.

Results: In 5 (4 female, 1 male, mean age 67 years) of 176 patients, MRI-examination revealed an early stage ON (prevalence 2.8%). Fifty-three of the 176 patients were older than 65 years. In this group, prevalence was 9.4%. All patients were treated arthroscopically by curettage or drilling of the lesion. Three out of 5 patients showed an additional degenerative lesion of the dorsal medial meniscus.

Conclusion: The prevalence of early stage ON in elderly patients with meniscal symptoms without trauma history is nearly 10%. Extending the preoperative diagnostic procedure in this setting to an MRI-examination could avoid pitfalls in the treatment of suspected meniscal tears in elderly patients.

109. PRIMARY PRESS-FIT STABILITY OF OSTEOCHONDRAL AUTOGRAFTS: COMPARISON OF DIFFERENT TRANSPLANTATION SYSTEMS. A BIOMECHANICAL AND RSA ANALYSIS. ***Jochen Duchow****; Frank Adam; Thomas Hess; Dieter Kohn*

Objective: 1. To compare the primary press-fit stability of osteochondral grafts transplanted with different surgical systems and to examine the effect of cyclic preloading on primary press-fit stability.

Methods: Osteochondral grafting procedures were carried out on porcine femurs. A single osteochondral graft of 8 mm diameter and 15 mm depth was transferred with each system tested. 1. OATS-System (Arthrex, Naples, USA). 2. COR-System (Innovasive Devices Inc., Marlborough, USA) 3. DBCS-System (Stratec, Freiburg, Germany). 4. Mosaic-System (Accufex, USA). Press-fit stability was tested by pull-out testing in a material testing machine with and without cyclic preloading of the grafts. Ultimate failure loads were recorded. For cyclic preloading, pressure was applied directly to the surface of the graft by a metal rod oriented perpendicularly to its surface. Either 100 or 1000 cycles with a minimal force of 10N and a maximal force of 100N were carried out. Those grafts preloaded with 1000 cycles were additionally prepared for Roentgen Stereometry Analysis (RSA) to examine load dependent micromotion of the grafts after preloading. Statistical analysis was performed with Anova test for multiple samples.

Results: Mean primary stability as evaluated by pull-out was 59N for the OATS System (range 14-114N), 204N for the COR-System (range 100-314N), 244N for the DBCS System (range 122-396N) and 137N for the Accufex system. Means differed significantly between the systems tested ($p<0.01$). In the 100 cycles group there was no significant effect of cyclic preloading on press-fit stability. In the 1000 cycles group increased micromotion, as detected by RSA analysis, correlated with lower press-fit stability.

Conclusions: Primary press-fit stability of osteochondral grafts of the same size depends on the device or instruments chosen for grafting. RSA showed that those grafts with increased micromotion after cyclic preload yielded lower press-fit stability.

110. INDENTATION ANALYSIS OF THE REPAIR TISSUE AFTER AUTOLOGOUS CHONDROCYTE TRANSPLANTATION. ***I. Kiviranta, MD, PhD****; A. Vasara, MD; A. Lindahl, MD, PhD; L. Peterson, MD, PhD*

OBJECTIVE: We wanted to evaluate biomechanical properties of the repair tissue after chondrocyte transplantation of the cartilage lesions in the femur.

MATERIALS AND METHODS: Using an arthroscopic indentation instrument cartilage stiffness was measured during knee joint arthroscopy from 19 patients with a follow-up time of 1 to 7 years after autologous chondrocyte transplantation. After indentation measurements cartilage biopsy was taken from 12 repair sites of 9 patients. Histological sections were stained with safranin O or treated with collagen type II antibodies. The study protocol was approved by the ethical committee of Jyväskylä Central Hospital and the patients gave their informed consent.

RESULTS: After autologous chondrocyte transplantation the biomechanical testing showed that indentation force (the measure of cartilage stiffness) in all repair sites was 2.6 ± 1.0 Newtons ($n=19$) and 3.3 ± 0.8 N in the adjacent, normal looking cartilage ($p=0.03$, Wilcoxon matched-pairs signed-ranks test). In the repair sites where the tissue was histologically cartilage like and showed also positive staining with collagen type II antibodies the indentation force was 2.7 ± 1.0 N ($n=8$), and $2.8+1.0$ N in the adjacent area. Indentation forces of the fibrous type of the repair tissues were significantly lower 1.2 ± 0.1 N ($n=4$, $p=0.01$, Mann-Whitney U-test).

CONCLUSIONS: Indentation analysis makes possible to obtain quantitative information about maturation process of the tissue after cartilage repair. The data show that indentation stiffness of the repair site correlates with the histological structure of the tissue. Indentation analysis might thus help to identify functionally competent repair tissue and to predict durability of the repair.

111. PRESS-FIT IMPLANTED OSTEOCHONDRAL AUTOGRAFT FOR TRAUMATIC AND DEGENERATIVE DEFECTS OF THE TALUS. ***Matthias Speck****; K.E. Brinkmann*

The purpose of this prospective study was to evaluate the results and clinical effectiveness of osteochondral autograft in treatment of traumatic and degenerative osteochondral defects of the talus.

Material and Methods: From September 1997 to May 2000, 25 consecutive patients with traumatic and degenerative full thickness chondral defects of the talus were operated according to an intra- and postoperative protocol. The study group consisted of 15 men and 10 women with a mean age at injury of 26.7 years (range, 14 to 46). The mean time between the onset of symptoms and operation was 8 months (1 to 18). Location of defect was lateral in 12 and medial in 13. The preoperative AOFAS score was 54 points (range, 45 to 67).

Results: All patients were available for an average 18 months follow-up (range, 6 to 32). 25/25 (100%) were improved and returned to increased levels of function. Sports activity level was unchanged in 20 patients (80%) and decreased in 4 cases (16%) respect to that prior injury. One patient (4%) did not return to sports activities. 21 patients were pain-free and 4 showed slight symptoms and swelling after full sports. The AOFAS score increased to 91 points (range, 79 to 100). Clinical data were statistically significant improved. Radiographical and MR evaluation after 6 and 12 months showed a healing of the graft in the defect.

Conclusions: Osteochondral autografts seem to be an efficient technique to treat a traumatic and degenerative osteochondral defect of the talus as it permits to fill the defect with a viable tissue which has the same biological and mechanical properties of the native tissue.

112. EFFICIENCY OF SPORT BRACES ON NORMAL AND THE ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTED BASKETBALL PLAYERS. ***Toru Fukubayashi, MD****; Kohtaro Ikeda, MD*

PURPOSE: To evaluate the positive and negative effect of knee braces in basketball performance.

MATERIAL AND METHOD: Ten female college basketball players who had no knee injuries were categorized as control group. Six female basketball players who received ACL reconstruction more than one year ago with semitendinosus and gracilis tendons were categorized as ACL group. Before and after wearing three types of ACL braces, seven types of performance tests were performed. They are one leg long hop, one leg side step, one leg figure of eight running, one leg step up and down, tapping, sprint running, and combination performance. Combination performance was simulation of the basketball movement, and was consisted with the dash, turn, jump, side step, and backward running. The ACL braces, which were used for this study, are Geltex (soft type brace, Sigmax company), EDO (hard type brace, EDO company), and Legend (hard type brace, Donjoy company).

RESULTS: In control group no brace and soft brace showed statistically superior results than the hard brace. In ACL group soft brace and hard brace mostly showed the same results as no brace. At the combination performance ACL group showed slightly better results

when wearing the soft and hard brace. In control group most players complained of the abnormal fitting feeling and the restriction of smooth motion when wearing braces. On the contrary in ACL group players had more stable feeling and the decrease of insecurity.

CONCLUSION AND SIGNIFICANCE: Knee braces are effective to keep the performance level, and the subjective stability in the ACL reconstructed basketball players.

113. VASCULARIZATION OF HAMSTRING TENDONS INSERTION. HISTOMORFOLOGICAL EVALUATION. ***Stefano Zaffagnini****; P. Golano; O. Farnas; V. De Pasquale; R. Strocchi; M. Marcacci*

PURPOSE: Evaluate the neurovascular network at hamstring insertion for preservation of tibial tendon insertion during hamstring ACL reconstruction.

METHOD: 4 fresh cadaver knees, were injected with India ink gelatin solution. The main arteries that give blood supply to this region were identified. Microscopic analysis of capillary vessels, and neurological fibers was performed. Computer system analysis was used to evaluate the area, number and diameter of vessels.

RESULTS: Superficial and deep branch of medial inferior geniculate artery, form an arterial arch that include inside the hamstring insertion. A wide spread array of small vessels and neurological fibers and terminations come into the gracilis and semitendinosus insertion and run along the length of the tendons, as confirmed by light microscopy data. Computer analysis revealed that the mean diameter of vessels decrease from 2201 micron at insertion region, to 661 micron in the middle part of the tendons. The area per sections decreases from 336.37 to 137.05 micromillisquare.

CONCLUSION: The presence of this neurovascular supply suggests that preservation of hamstring insertions during ACL reconstruction could speed up and improve the phenomen of ligamentization that normally occurs in a free graft.

114. VOLUNTARY (HABITUAL) ANTERIOR DRAWER IN CHRONIC ACL DEFICIENCY. *Nick London, FRCS;* ***Peter Myers, FRACS****; Jo Bullock-Saxton, PhD*

Background: There are a group of patients with ACL deficiency who are able to perform a voluntary anterior drawer. Some patients do this movement repeatedly such that it appears to have become habitual. The aim of the study was to identify the muscle(s) responsible for the action.

Methods: The study involved clinical and instrumented assessment, quantification of degree of voluntary tibial displacement using a computerised three-dimensional tracking device and electromyographic (EMG) studies of muscles acting around the knee.

Results: From observation it has become clear that the subject needs to have the foot planted on the ground to be able to perform the maneuver. The tracking device confirmed significant anterior tibial displacement compared to the normal side. Palpation of muscles did not indicate the muscles responsible for the action.

EMG studies revealed significantly increased activity in tibialis anterior during the voluntary drawer (with the lateral gastrocnemius acting as a co-contractor). There was no evidence of increased activity in other muscles acting on the knee either directly or indirectly.

Conclusion: The patients able to perform the voluntary drawer utilise tibialis anterior acting against a fixed foot to sublux the tibia forward. This maneuver (and similar rehabilitation exercises) should clearly be discouraged during the rehabilitation process following reconstruction.

115. VALIDATION OF TUNNEL DRILL GUIDE DEVICES AND FREE HAND TECHNIQUE FOR ACL RECONSTRUCTION USING COMPUTER ASSISTED ORTHOPAEDIC SURGERY (CAOS) SYSTEM. ***Jacques Menetrey****; D. Suva; P. Genoud; M. Sati; D. Fritschy; P. Hoffmeyer*

Introduction: The success of the reconstruction of the anterior cruciate ligament depends upon the placement of tibial and femoral tunnels. The goal of this study is to test the position of tunnels and the precision of drill guides and free hand drilling using the CAOS system.

Material and methods: 1) The validation of the free hand drill guided with the CAOS system was performed on plastic bone. Five target points were selected on tibial spines and in the femoral notch. With the help of a free hand guide controlled with the CAOS system, K-wires were drilled to target points. The distance between target points and K-wires tips was recorded. 2) An arthroscopic ACL reconstruction was performed on 5 cadaver knees. Tibial guides (Arthrex, Acufex, Phusis, Mitek), femoral rear entry guides (Phusis, Acufex) and trans-tibial guides (Arthrex, Mitek, Acufex) were used to place the tibial and femoral tunnels respectively. K-wires were drilled through the guides and internal/external tibial as well as femoral points were checked with CAOS. Once the points recorded, position of the graft was compared with the ideal graft initially determined with the CAOS system.

Results: Free-hand drilling guided by CAOS offers a sub-millimeter accuracy of 0.5 (0.41) mm. The Arthrex "PCL related" (8.1 (0.59) mm) and Acufex rear entry (3.1 (0.54) mm) guides positioned the graft too anterior, increasing the risk of impingement. The trans-tibial guides placed the femoral point 1.9 (0.1) mm posterior to the ideal point in a reproducible manner.

Conclusions: Free-hand drilling guided by CAOS offers a sub-millimeter accuracy that makes it suitable for clinical application. The "tip aimer" and trans-tibial guides allow a reliable and correct placement of tunnels. The free-hand technique guided by CAOS allows the placement of both femoral and tibial tunnels in the ideal position with both "outside-in" or "single incision" approaches.

116. USE OF A ROBOTIC SYSTEM FOR DRILL HOLE POSITIONING IN ACL SURGERY. ***Manfred Bernard, MD***

Objective: To minimize positioning problems in ACL - surgery.

Method: We use the robot system CASPAR (Computer Assisted Surgical Planning And Robotics) for planning and drilling the femoral and tibial tunnel. Preoperatively femur and tibia are marked with 2 positioning screws. Then a CT scan of both knees in maximum extension is performed and transferred to the planning station of the robot. With these data a three-dimensional image of both knees is established and the surgeon starts with preoperative computer simulation of the transplant positioning: The femoral insertion area is found by application of the "quadrant method," a radiographic measurement method, referring to the bony contours of the femoral condyle. The tibial insertion is found by superimposing both knees in the planning station, thus imitating normal ligamentous relations in the unstable knee. Then Blumensaat's line of the intact knee is lengthened. The intersection point of this line with the tibial plateau marks the ventral border of the tibial insertion. Intraoperatively these data are transferred to the robot, which transforms this planning by drilling the tunnels in the femoral condyle and tibial head.

Results: 34 patients were operated (july 1999 - april 2000). Follow-up consisted of radiologic and CT scan examinations. In two cases the robot had to be stopped because of errors in the preoperative planning and in two cases because of an impingement of the drilling tool in the knee. In the remaining 30 cases the drill hole positions were

measured and compared with preoperative planning. In 28 cases the preoperative planning was correctly transformed by the robot (maximum deviation +/- 5% of total diameter of lateral femoral condyle). In 2 cases the deviation of femoral tunnel was +6% and -12%.

Conclusions: CASPAR seems to be a reliable tool to minimize positioning problems in ACL surgery. In the planning station the surgeon sees simultaneously the bony contours in all 3 planes and can perform exact measurements of the insertion areas. Matching the intact knee to the unstable knee enables ACL reconstruction in consideration of the individual extensibility of the knee. The robot transfers this planning with highest accuracy to the intraoperative situation. One unsolved problem is the planning of an impingement-free direction of the drilling tool in the knee joint.

Significance: Intraoperative visual control of tool positioning and drilling procedure is absolute necessary.

117. BIOMECHANICAL EVALUATION OF PRESS-FIT GRAFT FIXATION TECHNIQUE IN ACL RECONSTRUCTION.

***Attila Pavlik, MD**; Peter Hidas, MD; Tibor Czigany, MD*

The success of anterior cruciate ligament reconstruction depends on many factors and among them the graft fixation is one of the most important ones. The fixation of the graft can be done by different interference screws but this method may have some disadvantages. The press-fit technique is an alternative method but there are not too much data about the mechanical properties of this technique. The purpose of this experimental study was to evaluate the primary stability of femoral press-fit graft fixation in ACL reconstruction.

We used 20 fresh cadaver knees (the average age: 47 years) for the measurements. The distal femur was stripped of soft tissue. We removed 10 mm bone-patellar tendon grafts from all specimen preparing it for press-fit technique. The shape of the bone plugs was trapezoid. The grafts were fitted into a 9 mm drill hole in the femur and then the femur was fixed on the test device (Zwick 020 computer controlled device). We measured the pull-out strength at varying angulations (0, 15, 30, 45, 60) to determine the optimal bone plug-ligament angle in the postoperative period. The test device applied 200 mm/min speed during the tests.

In the majority of the cases a plug dislocation could be provoked, but at 60 degrees ligament failure occurred at bone-ligament attachment or the femoral bone suffered. The average pull-out strength at 0 degrees was 312N (261-343), at 15 degrees was 353N (320-371), at 30 degrees was 485N (416-510) and at 45 degrees was 534N (507-554). At 60 degrees there were not enough successful measurements. The highest stability values were found at 30 to 45 degrees.

On the basis of our results the press-fit femoral graft fixation technique has competitive biomechanical properties in primary stability of the bone plug fixation compared to the interference screw fixation. The graft fixation at 90 degrees of knee flexion angle is appropriate for postoperative stability. These data show that it is not necessary to immobilise the knee in the postoperative period and an early rehabilitation can be recommended.

118. THE COAXIAL SCREWS – TENSION DEVICE – A NEW ONE STEP FIXATION TECHNIQUE TO BUILD UP LIGAMENT TENSION IN CRUCIATE LIGAMENT SURGERY.

***Moises Cohen**; Roland Jakob; Geraldo M. Reis; Rene Jorge Abdalla*

Recent scientific data suggests that cruciate ligament tension at surgery should be quantified to avoid over or underconstraining the knee and reduce the risk of failure of the graft, cartilage damage or loss of stability. Other factors are intimately connected with graft tension like positioning of the tunnels, graft orientation, twisting of the transplant and the amount of knee flexion in which tension is applied.

A method for tension quantification has been developed based on the principle of controlled torque application that combines direct graft fixation. The method has been utilized with hamstring tendons and patellar ligament fixing the graft first solidly in the femur either with interference fit screws or other technique. Then the tibial side of the transplant is assembled in the device (Coaxial System, GM Reis). The system consists of two parts, the first one is to secure the graft, the second part, in connection with the first, builds up the desired tension using a specific torque device.

After initial mechanical tests for device specification we performed tests on 20 cadavers knee joints to standardize the surgical method and improve the instruments accuracy. Doing this we were aware that we build up a tension from outside, in parallel line to the tibial tunnel, that is reamed slightly larger than the device itself to avoid friction. We also are aware that we are unable to accurately measure the tension in the graft itself. However the tension built up from outside using the torque wrench was controlled and confined by a dynamometric measurement set up.

These two hypotheses, straight line construction between femoral and tibial tunnels and no friction among graft, device and tunnel wall, will allow the torque produced by the instruments to be transduced to the graft to create the tension that is reflected by the force set, e.g., 120-200 N. First clinical trials have been performed with a protocol using a tension of 120 N applied at full extension. The fixation completed, the constructs function is assessed using an intra-operative arthrometer reading (Rolimeter, Aircast®) at 25° at flexion to assure physiologic residual laxity of 5-6 mm. Secondary changes can easily be performed. Further clinical experience is needed to confirm the reproducibility of the method and its influence on the quality of the results.

119. ACL RECONSTRUCTION WITH DOUBLED HAMSTRING TENDONS IN RUGBY PLAYERS.

*Fabio Ziranu, MD; **Giuseppe Milano**; Pier Damiano Mulas; Carlo Fabbriciani*

Objective: The aim of this study was to evaluate the results of ACL reconstruction using the doubled hamstring tendons in selected group of patients that were engaged in a contact sport with high risk of injuries to the knee, such as rugby.

Methods: Between November 1997 and May 1998 we performed the ACL reconstruction in 18 rugby players (12 professional and 6 collegiate players). Age of the patients ranged between 17 and 40 years (mean age: 27.4 years). A chronic isolated ACL injury was present in 13 cases; in 4 cases there was an associated Grade III medial collateral ligament injury and in one case an associated postero-lateral laxity. In all cases we performed an arthroscopic ACL reconstruction using an autologous doubled hamstring tendon graft. The graft was fixed with a transcondylar screw (Transfix) on the femur and with an absorbable interference screw and a metallic staple on the tibia. All the patients followed the same rehabilitative program. Return to the sports activities was allowed after 6 months. The results were evaluated using the IKDC score. Instrumental evaluation of the anterior laxity of the knee was performed using the KT-1000 arthrometer.

Results: The follow-up was 2 years in all cases. The results obtained at the IKDC evaluation are reported on the following table:

Group	Normal	Nearly Normal	Abnormal	Severely Abnormal
Subjective	10	8	0	0
Symptoms	13	3	2	0
ROM	13	5	0	0
Ligaments	13	5	0	0
Overall	10	6	2	0

Conclusions and significance: The results reported in this study showed that the ACL reconstruction with doubled hamstring tendon graft using a rigid fixation device, such as the transcondylar screw, permits to obtain normal or nearly normal results in almost 90% of the cases, also in rugby players, that are subjected, during their sporting activity, to numerous high energy and speed traumas. Therefore, could be hypothesized that the quality of the ACL reconstruction with hamstring tendon graft is similar to that of reconstruction with patellar tendon graft.

120. TUNNEL WIDENING IN HAMSTRING ACL RECONSTRUCTION: A PROSPECTIVE CLINICAL AND RADIOGRAPHIC EVALUATION OF FOUR DIFFERENT TECHNIQUES. *Mark Clatworthy, MBChB, FRACS;* ***J.U. Buelow, MD****; L. Pinczewski, FRACS (a – Australian Institute of Musculoskeletal Research); S. Howell, MD; P.J. Fowler, MD; A. Amendola, MD*

Introduction: It has been proposed that tunnel widening in ACL reconstructions is due to excessive graft tunnel motion secondary to elastic fixation. This study determines whether techniques which fix the graft closer to the joint (interference screws), eliminate the bungy cord and are stiffer will decrease tunnel widening. The clinical significance of tunnel widening is examined.

Method: Two hundred and fifty-nine patients were evaluated prospectively. Four fixation methods were evaluated. Sixty-nine were reconstructed using an endobutton and staples (elastic fixation). Forty-eight were subjects reconstructed with a bone mulch screw and staples, fifty-five patients were reconstructed with metal interference screws and eighty-seven with bioabsorbable interference screws. Patients underwent a clinical examination, IKDC, Cincinatti knee score and KT-1000 testing one year post-operatively. These factors were correlated with tunnel widening. Tunnel widening was determined using magnification adjusted AP and lateral radiographs using Scion Image software.

Results: Tunnel widening occurred with all the fixation methods. Mean tunnel area increased 122% for the Bioscrew, 89% for the metal interference screw, 76% for the bone mulch screw and 36% for the endobutton (ANOVA $P<0.0001$). Tunnel widening did not correct with increased laxity, poor IKDC or Cincinatti knee scores.

Conclusion: Tunnel widening occurs with both elastic and rigid fixation methods. Tunnel widening cannot be avoided by fixing the graft closer to the joint or eliminating the "bungy cord." Graft tunnel motion is not the sole cause of tunnel widening in ACL reconstruction. Tunnel widening does not correlate with poor outcome in the short term.

121. EVALUATION OF BONE TUNNEL ENLARGEMENT AFTER ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION USING THREE-DIMENSIONAL COMPUTED TOMOGRAPHY. ***Kenzo Kawasaki, MD****; Mitsuo Ochi, MD, PhD; Yuji Uchio, MD, PhD; Junji Iwasa, MD*

PURPOSE: The purpose of this study was to evaluate the bone tunnel enlargement using three-dimensional computed tomography (3D-CT) after anterior cruciate ligament (ACL) reconstruction.

METHODS: We studied (i) bone tunnel morphological / quantitative features and (ii) their correlation with post-operative instability using x-ray radiography and 3D-CT after ACL reconstruction for 44 patients (19 females, 25 males; mean age: 26.7 yr, follow-up period of 18 months). Side-to-side difference of anterior displacements of the tibia with a KT-2000 knee arthrometer and analyses with anteroposterior/lateral x-ray radiography and 3D-CT were performed on the treated knees at 18 months post-operation.

RESULTS: Based on 3D-CT evaluations of bone tunnel, three morphological patterns were observed: column (40.9%), beer-barrel (38.6%) and trumpet (10.5%) types. Studies with KT-2000 arthrometer revealed insignificant differences among any 2 of the 3 groups (enlargement, non-enlargement and non-detectable), using x-ray radiography, although 3D-CT evaluations indicated the bone tunnel size of the trumpet category was the largest ($p<0.05$). A significant correlation ($Y=3.59\pm0.244*X$; $R2=0.714$, $p<0.05$) between the enlargement rate of the intraarticular entrance and anterior instability of the femur was verified.

CONCLUSION: As 3D-CT could establish morphological and quantitative aspects of the bone tunnel, it may therefore be useful for evaluation of post-reconstruction bone tunnel enlargement in clinical diagnosis.

122. MIGRATION AND STIFFNESS OF THE PATELLAR TENDON GRAFT IN ACL RECONSTRUCTION UNDER SUBMAXIMAL LOAD. AN IN VITRO STUDY USING ROENTGEN STEREOMETRIC-ANALYSIS (RSA). ***Frank Adam****; Dietrich Pape; Oliver Steimer; Dieter Kohn*

PURPOSE: To evaluate micromotion of the BPTB bone-plug under increasing load.

METHOD: 10 porcine tibiae with patellar tendon were used. In all trials a BPTB bone-plug with 10 mm diameter 25 mm length was prepared for a 10 mm diameter tunnel. The graft was fixed in outside-in technique with a 7/25 mm interference screw alternating biodegradable and titanium screws. Tibia, bone-plug and interference screw were marked with tantalum beats. The grafts were then loaded axially under RSA control increasing the force in steps of 50 N. After each step RSA measurement without any load was performed to evaluate the plastic deformation. Micromotion between bone-plug, screw and tibia were measured with RSA.

RESULTS: There was no significant difference in the pull out strength between biodegradable screw (∅ 648 N) and titanium screw (∅ 667 N). The linear stiffness tended to be higher for the bioscrew ∅ 3058 N/mm (1440-5454) compared to the titanium screw ∅ 1928 N/mm (1449-2400). Plug migration of more than 0.36 mm/50 N in line with the tunnel indicated failure of the fixation. Maximum total migration of the bone-plug before failure was measured with 0.9 mm. Between the tantalum beats in the bone-plug itself no measurable micromotion could be detected indicating no breakage or lengthening.

CONCLUSION: The BPTB graft fixation with interference screw showed a high linear stiffness. The BPTB screw fixation failed after migration of the bone-plug less than 1 mm.

SIGNIFICANCE: The evaluated stiffness could be used as a reference for other graft fixation methods.

123. ALTERATIONS OF THE EXTENSOR APPARATUS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING THE MEDIAL THIRD OF THE PATELLAR TENDON. ***Ulf Moebius****; Anastasios Georgoulis; Anastasios Papadonikolakis; Christos Papageorgiou*

Purpose: Ultrasound evaluation of the donor defect of the patellar tendon (PT) and the radiological investigation of the patella after harvesting of the medial third of the PT as a BPTB graft.

Materials and methods: The extensor apparatus was studied in 45 patients, 3-70 months post-operatively, which are divided into two groups: group A, 3-30 months and group B, 31-70 months after ACL reconstruction using the medial third of the PT. X-ray pictures, anterior-posterior, lateral and a tangential view of the patella were examined and also standard ultrasound cross sections of the PT. The contra lateral knee was used as a reference.

Results: The standard ultrasound cross section surface of the PT increased in group A by 20.48% and decreased in group B by 4.88%. The X-ray control showed a decrease in patellar height of 9.21% in Group A and 7.02% in Group B. The increase in the Merchant's congruence angle of about 11.59° for group A and 3.82° for group B indicated a not statistically significant lateral displacement of the patella after the 30th postoperative month.

Conclusions: After harvesting of the medial third of the PT for ACL replacement, all changes in the extensor mechanism are similar to those after harvesting the central third of the PT. The tendon defect always fills and the final tendon achieves 95% of the original tendon size. There is a non statistically significant slight lateral displacement of the patella in comparison to the slight medial displacement after using the central third of the PT. The shortening of the PT is similar to shortening after using the central third and within the limits of technical error.

Results of evaluation of ultrasound and X-ray pictures

	Operated Knee	Other Knee	Changes	Change (%)	
Area of the patellar tendon slices 1-30 months	1.99 cm^2 sd: 0.20	1.66 cm^2 sd: 0.14	0.33 cm^2	20.48%	p=0.05
30-70 months	1.57 cm^2 sd: 0.19	1.65 cm^2 sd: 0,18	-0.08 cm^2	-4.88%	p=0.0008
	p=0.03	p=0.44	p=0.01		
Congruence angle 1-30 month	6.24° sd: 7,50	-5.35° sd: 5,06	11.59°		p=0.0004
30-70 months	-1.03° sd: 1,88	-4.85° sd: 6,78	3.82°		p=0.38
	p=0.007	p=0.15	P=0.009		
Lateral patello-femoral angle 1-30 months	18.08° sd: 4.12	16.97° sd: 4.52	1.11°	6.54%	p=0.18
30-70 months	18.71° sd: 4.68	17.42° sd: 4.21	1.30°	7.45%	p=0.15
	p=0.12	p=0.23	p=0.09		
Patellar height 1-30 months	32,8mm sd: 4.42	36,1 mm sd: 3,93	-3,32 mm	9.21%	p=0.01
30-70 months	32,2mm sd: 4.95	34,6 mm sd: 4,63	-2.43 mm	7.02%	p=0.03
	p=0.08	p=0.12	p=0.04		

124. PROGNOSIS OF DONOR PATELLAR TENDON, IN THE ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT OF THE KNEE.

Benigno Zenteno, MD; *Alfredo Ceniceros, MD; Nicolas Zarur, MD*

PURPOSE: Demonstrate that the use of the patellar tendon autograft for the reconstruction of the anterior cruciate ligament (ACL) is not detrimental, and that with sufficient time the area recovers its normal ultrasonographic appearance and function.

METHOD: Twenty adults without history of knee complaints were utilized as a group control, each of whom underwent bilateral diagnostic ultrasounds of the patellar tendon. The investigational group consisted of 20 patients who had undergone ACL endoscopic reconstruction with patellar tendon autograft. Both groups were examined by one radiologist, using a single-blind method. The radiologist was unaware of the postoperative time period. The contralateral knee was as well examined in all patients. One surgeon performed the surgeries. The donor site was closed in all cases. The results were analyzed statistically with T-paired and regression analysis tests. A morphologic staging classification was established.

RESULTS: The average age in the control group was 27.45 years, and in the operated patients 27.05 years. The time from surgery to ultrasound examinations varied from 4 months to 6 years. In the control group there was no difference between both measured knees in the same subject. All the reconstructed patients had a significant difference between the operated knee and the contralateral joint (T-paired test) with a linear tendency to normality with time ($p < 0.01$). It was noted that the patients who were over 46 months post-operative demonstrated a normal appearance of the patellar tendon, but never before this period of time.

CONCLUSION: The autologus patellar tendon graft for the reconstruction of the anterior cruciate deficient knee is a common and innocuous procedure. The remaining patellar tendon recovers normal function quickly, but a normal ultrasonographic appearance is not regained until several years after surgery.

SIGNIFICANCE: According to our data, the time of full recovery of the donor site of the patellar tendon autograft is more than it was reported before. In our study, the majority of patients demonstrated persistent signs of thickening and edema in the patellar stump after 18 months. Therefore the orthopedic surgeon needs to be aware of this situation, for the handling of his reconstructed patients.

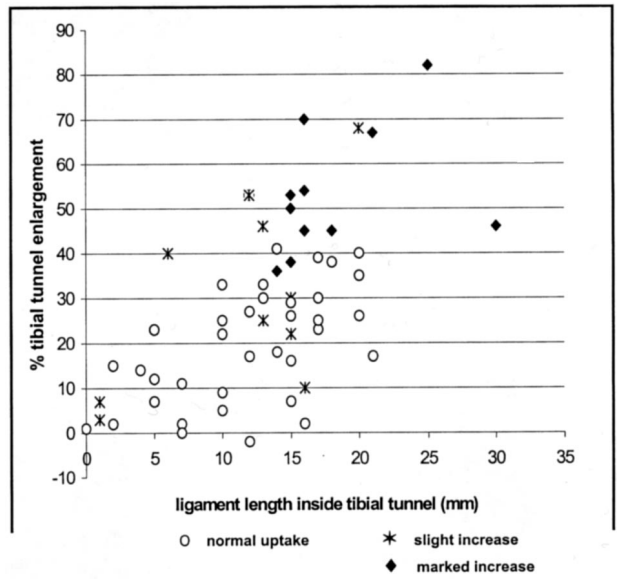
125. ABNORMAL BONE SCANS OF THE TIBIAL TUNNEL 2 YEARS AFTER PATELLA LIGAMENT ACL RECONSTRUCTION: CORRELATION WITH TUNNEL ENLARGEMENT AND TIBIAL GRAFT LENGTH.

T. Hogervorst, MD; *C.P. van der Hart, MD; T.H. Pels Rycken, MD; W.K. Taconis, MD, PhD*

Objective: The role of graft characteristics in enlargement of the tibial tunnel after ACL-reconstruction is incompletely understood. Bone apposition to the ligament or tendon is a late phase in graft healing in a bone tunnel and relates to pull-out strength. We hypothesise that bone scintigraphy can visualise this process and that return of osseous homeostasis indicates the completion of graft healing in a bone tunnel.

Methods: Bone scans were made in 68 patients 2 years after patella ligament ACL-reconstruction. Scintigraphic findings were correlated to radiographic tunnel enlargement, tunnel position, ligament length inside the tunnel (patella ligament length between bone plug and joint line), static anterior laxity (KT-1000) and subjective outcome.

Results: In femur tunnels, enlargement or increased scintigraphic uptake was not seen. In tibial tunnels, uptake was markedly increased in 16% and slightly increased in 15%. Scan uptake was correlated to tunnel enlargement, graft length in the tibial tunnel (see figure) and tunnel position in the frontal plane. No correlation was found between scan uptake or tunnel enlargement and anterior laxity, sagittal tunnel position and subjective outcome.



Conclusion: Tibial fixation location influences ligament healing inside the bone tunnel: Fixation more than 14 mm below the joint can lead to tunnel enlargement and return of osseous homeostasis can take more than 2 years. We did not however, find a correlation between tunnel enlargement and outcome of ACL-reconstruction.

126. EARLY EXPERIENCE WITH THE TC3 KNEE PROSTHESIS.

***Michael Rigby, FRCS**; Christopher Servant, FRCS; Louis Pozo, FRCS*

OBJECTIVE: To assess the early results of the TC3 knee prosthesis, a modular system with stems and augments, in difficult primary and revision knee arthroplasties.

METHOD: 13 index procedures were undertaken for gross varus or valgus deformities with severe ligamentous incompetence and/or major bone defects. 18 procedures were revision arthroplasties, 7 being undertaken for sepsis. 28 knees underwent full clinical and radiological review at a mean of 25.8 months postoperatively, using the Hospital for Special Surgery Score and the Knee Society Score. 2 patients were interviewed by phone with recent radiological follow-up. One patient had died from unrelated causes.

RESULTS: All patients were very pleased with the outcome of surgery. The mean pre-operative alignment for the primary arthroplasties was 28° for the varus and 32° for the valgus knees. The mean postoperative alignment was 7°. The mean Hospital for Special Surgery score was 72.4 for primary arthroplasties and 72.7 for revision surgery. The mean Knee Society Knee Score was 77.9 and 75.1 respectively, and the mean Functional Score was 60.8 and 49.4 respectively. The latter reflects the elderly age, multiple joint involvement and constitutional status (including rheumatoid arthritis) of many of these patients. 4 patients experienced retropatellar pain. One patient with severe rheumatoid developed sepsis of the revision implant. Difficulties with tibial tray lateralisation and stem fixation will be discussed.

CONCLUSION: The TC3 knee system affords an excellent modular option to compensate for bone defects and ligamentous incompetence, achieving restoration of the joint line and satisfactory function.

127. POSTOPERATIVE RECOVERY AND EARLY RESULTS: MENISCAL BEARING KNEE VS. LEGACY PS.

***Andrea Baldini, MD**; Paolo Aglietti, MD; Luca Maria Vena, MD; Domenico Lup, MD*

Objective: This prospective randomized study compared the postoperative recovery and early results of two groups of patients undergoing Total Knee Arthroplasty: group I included patients with a fixed bearing posterior stabilized prosthesis (LPS), group II received the meniscal bearing prosthesis (MBK).

Methods: Each group included 70 patients. Preoperative parameters did not differ between the two groups. Body Mass Index averaged 27 in both groups. The PCL was sacrificed in group I and spared but completely released from the tibia in group II. Accurate posterior recesses work and removal of posterior osteophytes was done in all patients. All patients received the same rehabilitation protocol. Continuous passive motion was used for the first 24 hours postoperatively (0-70°). Evaluation was performed preoperatively, postoperatively at one week, one, 3, 6 and 12 months.

Results:

	1week	1 month	3 months			
	LPS	MBK	LPS	MBK	LPS	MBK
Maximum flexion	95±6°	91±4°	99±7°	97±8°	109±10°	108±11°
Extension loss	2±2°	2±2°	2±3°	1±2°	1±2°	0±2°
Pain (VAS:0-10)	3.5±1.9	3.3±1.6	2±1.4	1.8±1.5	0.5±1.2	0.5±1.1
	Preoperative	6 months	12 months			
Knee Score	39±7	43±8	94±4	93±5	95±4	94±3
Maximum flexion	102±7°	99±6°	109±8°	108±9°	114±9°	110±11°

No significant differences between the two groups were found. Subjective feeling of clicking in the knee was present in 4 patients (6%) of group I and 6 patients (9%) of group II (n.s.).

Conclusions: Using a fixed (PS) or a mobile bearing design didn't seem to influence the short term recovery and early results after knee replacement.

128. ASYMMETRICAL MULTICIRCUMVOLUTION ARTICULATION WITH GEARS ON INSTANTANEOUS CENTRE.

*Roberto Postelmans, MD; **Eric De Gunsch, MD***

PURPOSE: A study of an orthetic articulation 3D based on the physiological movement of knee.

METHOD: We consider that an orthetic three-dimensional knee joint cannot be carried out as a whole unless there is an internal and external part. This study has been achieved in 3 stages. In the first and second stage, presented in 1996, a software program has developed the following parameters:

- The length of the crossed interiors and posteriors
- The intercondylar fosa
- Its angle according to the mechanical axis
- The length of the tibia plane
- And also the pivot placed on the tibia medial condylar
- – on the other hand
- The rolling three-dimensional anteroposterior translation associated with the rotation and varus
- All this varying in time and amplitude as the flexion.

The third stage consists in generating a full control of the orthetic joint. Therefore we considered the base and the rolling of the instantaneous gears generated by the ACL/PCL.

RESULTS: The **A**symmetrical **M**ulti**C**ircumvolution **A**rticulations generate either three-dimensional grooved cams or complex surfaces predetermined by the expected movement. The two curves, of the instantaneous gears, are the only ones to possess this property, that is a pure rolling. Precisely this pure rolling allows us to put gears on the course of the base and the rolling. These are going to cooperate during the flexion/extension to obtain a physiological movement.

CONCLUSION: Thanks to these gears, precisely located on the instantaneous centre, we achieve a new concept of joint 3D with anteroposterior rolling and gliding associated with a rotation and varus, the whole system controlled in time.

129. TOTAL KNEE ARTHROPLASTY ASSOCIATED WITH OSTEOTOMY FOR GONARTHROSIS, WITH MAJOR EXTRA-ARTICULAR DEFORMITY (14 KNEES).

***J.L. Lerat**; A. Godeneche; B. Moyen; J.L. Besse*

PURPOSE: In rare cases of severe gonarthrosis associated with major frontal or rotational extra-articular deformity, the classical treatment has been constrained hinged total knee arthroplasty (TKA) or posterior-stabilized TKA with a large ligament release. A non-constrained TKA could be also performed after an initial correction of the deformity had been made by osteotomy. In this series TKA and osteotomy has been performed in a single step.

METHODS: The series comprised 14 knees in 13 patients, 9 female and 4 male patients aged 74 ± 7 years (60 - 87) which were operated on between 1990 and 1998. Average follow-up period was 43 ± 21 months (10 to 2 years). The aetiology was represented by an overcorrected closing wedge high tibial osteotomy (7 knees), congenital deformity (5 knees), post-traumatic cases (1 knee) and 1 due to rickets. For 6 varus knees the HKA angle was : 160 ± 8° (140 – 168°) and for 6 valgus knees: 197 ± 9° (187 – 210°). 2 cases had internal

malrotation and varus. The mean extra-articular deformity was 14.7° and 11° for varus and valgus respectively. The authors discuss the surgical technique which varies according to whether the deformity is tibial (11 knees) or femoral (3 knees). The technique was original at the beginning of the series. Evaluation was made using IKS and HSS scores and alignment measured by full length bi-podal weightbearing X-rays.

RESULTS: The association of osteotomies did not adversely affect the results of the TKAs which indeed were comparable to those reported in the literature. The HKA angle was 177 ± 5° for the varus group and 178 ± 3° for the valgus group. This alternative has several advantages: the conservation of the PCL, of the joint line position, of the patellar height and of the length of the limb.

CONCLUSION: In rare cases of severe gonarthrosis associated with major frontal or rotational extra-articular deformity, it is preferable to perform TKA and osteotomy as a single step rather than carrying out 2 successive operations.

130. OVERCORRECTION OF TIBIO-FEMORAL ANGLE IN TOTAL KNEE ARTHROPLASTY. *Yong Hoon Kim, MD*

PURPOSE: To prevent undercorrection of alignment after total knee arthroplasty in severe varus deformed knee by overcorrection of distal femur cutting.

MATERIALS AND METHOD: 302 patients who had received TKA from April 1994 to December 1999 were analyzed. They were divided into 2 groups. In group I, distal femur was cut at valgus 7 degree in every case. In group II, distal femur was cut at different degree according to its preoperative tibio-femoral angle. Varus 5 to 9 degree was cut at 8 degree and more severe varus was cut at 9 degree. We evaluated pre- and postoperative tibio-femoral angle in standing position.

RESULTS: In case of varus 5 to 9 degree, postoperative valgus was 4.2 degree in group I. In case of severe varus which was above 9 degree, postoperative valgus was 3.8 degree in group I and 4.8 degree in group II.

CONCLUSION: In severe preoperative varus deformity, over-correction of femoral, valgus cut is helpful for obtaining proper postoperative tibio-femoral angle in total knee arthroplasty.

PROPOSED IDEA: If preoperative tibio-femoral angle is between 5 to 9 degree, we suggest that femur should be cut at valgus 8 degree (i.e., 1 degree overcorrection). If preoperative tibio-femoral angle is above varus 9 degree, femur should be cut at valgus 9 degree (i.e., 2 degree overcorrection).

131. OPTOELECTRONIC IN VITRO ANALYSIS OF CONTINUOUS MOTION AND STABILITY OF A KNEE WITH UNICONDYLAR OR TOTAL PROSTHESIS. *Jean-Yves Jenny, MD (a – Aesculap AG, Tuttlingen); David Binkert, MD; Wafa Skalli, PhD; François Lavaste, PhD*

PURPOSE: The authors developed an original jig to analyze the changes in the normal knee kinematics and stability after implantation of different types of prostheses and according to the ligamentous status.

METHODS: 12 fresh freezed gross specimens without macroscopic cartilage damage have been studied. The jig simulated the movement of sitting down on a chair. Stability was tested at 20° and 75° of knee flexion with an anterior and posterior force of 12 daN. Six situations have been tested: normal knee, medial unicondylar prosthesis with intact, then resected anterior cruciate ligament (ACL), unconstrained total prosthesis with intact, then resected posterior cruciate ligament (PCL), posterostabilized total prosthesis (Search System, Aesculap, Tuttlingen, FRG). Bone displacements have been measured with the VICON optoelectronic system (Oxford Metrics, Oxford, UK). Three-dimensional displacements have been plotted against knee flexion.

RESULTS: Implantation of a medial unicondylar prosthesis did not modify the kinematics of the normal knee in all ligamentous situations. Implantation of a total prosthesis was followed by absence of tibial internal rotation from 0° to 30° of knee flexion, and then its decrease from 30° to 90° of knee flexion in all ligamentous and prosthetic situations; there was no significant modification in the other directions.

ACL section was followed by an increase in anteroposterior tibial translation in all prosthetic situations. PCL section was followed by an increase in anteroposterior tibial translation after total prosthesis implantation. Implantation of a posterostabilized prosthesis returned tibial anteroposterior translation to normal.

There was a positive correlation between anteroposterior tibial translation at 20° of knee flexion and the kinematic changes between 0° and 30° of knee flexion after unicondylar prosthesis implantation. There was no such correlation after total prosthesis implantation.

CONCLUSION: Kinematics and stability of a medial unicondylar prosthesis depends on the status of ACL and PCL, with nearly no change if they are intact. Kinematics of a total prosthesis depends on the geometry of the implant, while the status of ACL and PCL has little influence on stability.

132. MECHANICAL FAILURES IN TKA AT 10 YEARS F.U. *O. Tayot; **T.A.S. Selmi**; Ph. Neyret*

Introduction: The goal of this study is to analyze the reasons for mechanical failures at long term follow-up.

Material and method: From 1984 to 1988, 329 patients underwent 376 cemented postero-stabilized TKA. They were successively reviewed at 3 different dates - 1989, 1994, 1998. In 1998 follow-up (F.U.) was obtained in 306 prosthesis (81.4%): 118 were dead, 163 were reviewed clinically and radiographically. 25 were revised: 15 due to infection, 10 due to mechanical failures.

Results: In 1998 average age was 78 years and mean F.U. was 11.5 years (9 to 14 years).

– Knee score did not vary with time ($p < 0.0001$)

– Functional score decreased regularly with a linear manner ($p = 0.0001$) from 70/100 in 1989 to 60 in 1998. A wider variability was noticed in older patents ($p = 0.0001$).

– Average Mechanical Tibio-Femoral Angle did no vary with time (178°, range 167°-187°). We noted 28 tibial polyethylene which was wears always < 3 mm. Kaplan-Meier estimates were 93.7% (+/- 1.6) at 14 years F.U., 86% (+/- 3.8) at 14 years F.U. Mechanical failure was only observed in case of pre-operative severe osteoarthritis defined by a marked bone-loss and the absence of an Anterior Cruciate Ligament.

Discussion and Conclusion: At 11.5 years mean F.U., cemented P.S. TKA is a reliable procedure. Considering mechanical failure stage of osteoarthritis at operation (marked bone-loss, absence of ACL) was the principle prognostic factor.

133. COMBINED PARASACRAL SCIATIC AND FEMORAL NERVE BLOCK, FOR POSTOPERATIVE ANALGESIA FOLLOWING TOTAL KNEE REPLACEMENT. *Carlos Bollini, MD; Guillermo Arce, MD; Pablo Lacroze, MD; Jorge Macias, MD*

BACKGROUND AND OBJECTIVES: Quality of analgesia and subsequent opioid requirements following spinal anesthesia (SAB), spinal anesthesia with a femoral nerve block (SAFB) or spinal anesthesia with a combined femoral parasacral sciatic nerve block (SACF-PSB) for total knee replacement were compared.

METHODS: In a prospective, double blind, randomized controlled fashion 105 patients undergoing TKR were studied. All patients received a standard spinal anesthesia with 3 ml of plain bupivacaine 0.5%. The SAFB group (n=35) and the SACFPSB group (n=35) received before surgery, a femoral nerve block with the aid of a nerve stimulator, 20 ml of bupivacaine 0.5% with epinefrine 1:200,000 were injected after eliciting a quadriceps muscle response at low intensity current (<0.4 mA). Concluded the surgical procedure a parasacral sciatic nerve block with the aid of a nerve stimulator, and 20 ml bupivacaine of 0.375% without epinefrine were injected to the SACFPSB group, after eliciting plantar flexion of the foot with <0.5 mA. All patients received diclofenac 150 mg/24hs, and meperidine IM 1 mg/kg/6h due to pain requirements. Visual analog pain scores (VAS 0-100 mm) and cumulative meperidine consumption were recorded for 48 hours following surgery.

RESULTS: Opioid consumption was significantly higher in the SAB group during the first 24 hours but similar to the SAFB and SACFPSB group thereafter. Opioid consumption during the first 18 hours was significantly lower ($p<0.05$) in the SACFPSB than in the SAB and SAFB groups.

CONCLUSION: Adding a parasacral sciatic block to the femoral block resulted in superior analgesia and reduced morphine consumption for the first 24 hours following TKR.

134. HLS TOTAL KNEE ARTHROPLASTY: A REPORT OF 610 CONTINUOUS CASES. *T.A.S. Selmi; L. Jacquot; Ph. Neyret*

Introduction: The aim of this study is to report on the results of a continuous, homogenous series of patients operated according to the same technical principles, with the same type of prosthesis, under the supervision of one surgeon during 11 consecutive years.

Material and method: 610 MS total knee arthroplasties (postero stabilized with a third median condyle) have been implanted in 556 patients from January 1988 to October 1999. All components were cemented. Clinical assessment was made according to the IKS criteria. Main aetiology was osteoarthritis (82%). Mean age at operation was 70.6 years. 95% of cases had follow-up evaluation. 402 arthroplasties have been evaluated with a follow-up longer than one year. Early results of 88 mobile bearings were also analysed.

Results: Mean follow-up is 3 years and 4 months. 96.6% of the patients were satisfied or very satisfied. 13 patients were deceived, mainly because of ongoing pain. Mean knee score was 78/100. 96% of patients had no or slight pain. Mean function score was 63/100. 27% of patients belonged to IKS category C. 85% of patients were sedentary or walked only on flat ground. Mean flexion was 111°.

Mean postoperatory femoro tibial axis was 178.4°. There was 2% of cutaneous problems, 1.6% of pulmonary embolism and 1.5% of confusion.

12 cases needed resurgery, 6 concerning the extensor apparatus. Survival rate according to Kaplan-Maier was 99.13% with a 95% confidence interval.

Conclusion: Continuous following of this series confirms reliability of this cemented, postero stabilized total knee prosthesis.

135. MALUNIONS AND TOTAL KNEE REPLACEMENT. *X. Zanone; T.A.S. Selmi; Ph. Neyret; M. Dejour*

Introduction: Post-traumatic extra-articular angular deformities of the tibia or femur lead to mechanical axis deviation of the lower limb and malorientation of the joints above and below. Total knee replacement in these situations may be difficult residual malalignment may give inferior results in the long term and balancing soft tissues may be rendered difficult by the extra-articular deformity.

Material and methods: 81 femoral or tibial shaft malunions operated between November 1976 and June 1998 were retrospectively reviewed: 48 femurs, 30 tibias, 3 femur and tibia associated —> 49 degenerative osteoarthritis of the knee. In the frontal plans the angle formed by the deformity and the distance between the malunion and the knee were measured on X-rays. This permitted us to calculate the resulting malorientation of the knee (the closer a deformity is to the knee, the greater its repercussion at this level). We considered as a malunion a deformity in the frontal plane resulting in a malorientation of the knee of > 2° (resultant at knee joint level) or a sagittal or torsion deformity of more than 5°.

Results and discussion: 21 patients had TKR following malunion: 15 femurs and 6 tibias. 6 of these patients had a previous osteotomy, and in two cases the TKR was performed simultaneously with a high tibial opening wedge valgus osteotomy (to correct the extra-articular deformity). In the frontal plane, if the deformity is not corrected extra-articularly, by an osteotomy, it must be corrected by compensatory distal femoral or proximal tibial wedge resection to produce overall limb alignment. Because such a wedge resection between the proximal and distal attachments of the collateral ligaments will produce asymmetrical ligament length, complex instabilities may result. TKR and torsional deformity: 9 TKR were performed in cases of malrotation: 7 external torsions and 2 internal torsions.

In two of these cases the torsion deformity (20-25°) was corrected prior to the TKR by an osteotomy. In no case was the torsion deformity corrected during the TKR procedure. In these cases of torsional malunion balancing soft tissues is no major problem, as the gap created by the TKR cuts is symmetric in flexion and extension. On the contrary, patello-femoral maltracking may be a problem. It must be considered that when the malrotation is not corrected by an osteotomy, this persisting deformity might be responsible for rapid wear of the TKR components (as it might have been responsible for the OA).

Conclusions: Extra-articular deformities following malunions may produce osteoarthritis of the knee. Torsional deformities seem to play an important role in the localization of the osteoarthritis. In performing TKR after tibial or femoral shaft malunions it is important to take into account all these parameters. The correction of the extra-articular deformity by an osteotomy must be considered, taking into account the importance of the deformity at the level of the knee and the age and activity level of the patient.

136. INFLUENCE OF PREOPERATIVE DIAGNOSIS TO THE CLINICAL OUTCOME OF TKR. *Valdis Zatlers; Vitolds Jurkevich*

Purpose. It is often difficult to predict the clinical outcome of TKR before surgery. We were interested to find out, do the presurgery conditions such as post-traumatic arthritis JR), rheumatoid arthritis (RA), previous high tibial osteotomy (HTO) or osteoarthritis with severe bone loss (BL) influence the TKR overall clinical outcome.

Methods. 128 consequent patients with 0.5-3.5 year follow-up after TKR were assessed by the same independent examiner. 51 (40%) of the patients were special conditions (RA-17 (13%), HTO-7 (5%), TR-20 (17%), BL-7 (5%)). Data was recorded using Knee Society Scoring system. The clinical outcome scores of each special group were compared to the overall scores of the whole group.

Results. Osteotomy group had the lowest knee score 78 points (mean 83 points) and pain score 40 points (mean 44 points). Rheumatoid arthritis group had the lowest walking score 37.6 points (mean 40 points) and functional score 76 points (mean 79 points). The lowest ROM had post-traumatic (95 degrees) and osteotomy (94 degrees) groups (mean 100 degrees). Bone grafting group had the best knee score 86 points, ROM 103 degrees, pain score 47 points and walking ability 45 points.

Conclusions. Less satisfactory results showed patients with previous high tibial osteotomy. This procedure is not recommended for treatment of severe osteoarthritis and should have definite indications. Rheumatoid arthritis patients had the lowest walking and functional score because of affected other joints. The best clinical outcome scores showed patients from severe bone loss group, who all were treated by bone grafting during TKR. This procedure is safe and leads to excellent clinical results.

137. OSTEOTOMY OF THE TIBIAL TUBERCLE IN REVISION TOTAL KNEE ARTHROPLASTY. A SIMPLE METHOD OF RE-ATTACHMENT. ***Basil Kaufman, MBBCh., FRCS****; Shmuel Israeli, MD*

Revision arthroplasty of the knee can be very demanding. Not infrequently is the patellar tendon stuck down to the underlying upper Tibia following previous surgery for Total Knee Arthroplasty or High Tibial Osteotomy. This fact complicates the exposure of the knee during revision arthroplasty, often resulting in disruption of the patellar tendon attachment, partially or wholly, from the tubercle tuberosity.

In order to avoid this unnecessary complication, osteotomy of the Tibial tubercle offers good exposure and easy access to the upper tibia for the implantation of the prosthesis but the central post of the Tibial tray does not permit direct screw fixation of the osteotomized tuberosity.

We present a hitherto unpublished method developed in our department whereby the tuberosity is re-attached using the tension band principle and not interfering in any way with the Tibial tray. This allows for early mobilization of the knee and does not interfere in anyway with the rehabilitation program.

The method has been used successfully in 21 patients all of whom have gone on to full union with no "pull-off" or wire break. One case required revision bone grafting to achieve union, the osteotomy having been too thin. One case the fixation had to be removed because of sepsis.

138. PATELLA NON-RESURFACING IN TKA. EVALUATION OF 1777 MOBILE BEARING KNEES WITH A 2 TO 15 YEAR FOLLOW-UP. ***Urs Munzinger, MD****; Jens Boldt, MBBS; Mario Bizzini, PhT; Peter Keblish, MD*

PURPOSE: To evaluate complications in 1777 Low Contact Stress (LCS) mobile bearing TKA without patella resurfacing from two major total joint centers.

METHOD: There were 1777 of 3621 TKA with a 2 to 15 year follow-up (mean 3.7 years). Radiographic assessment was carried out in the 200 cases with the longest follow-up (mean 9.2 years).

RESULTS: 94.6% had excellent or good clinical results. Of the 1777 cases 19 (1.1%) patellae were secondarily resurfaced due to anterior knee pain, and are considered true failures. 21 patellae were resurfaced incidentally when revision of the femoral or tibial component was performed. Perfect tracking (patella crown to mid-femoral sulcus less than 2 mm) was noted in 193 (96.5%) cases. Seven cases showed lateral patella orientation from 2 to 6 mm. Asymptomatic remodeling of the lateral patella facet was seen in 19 (9.5%) cases.

CONCLUSION: These data support the non-resurfaced patella approach in TKA with a mobile bearing knee system that includes a pateIla-friendly design, proper soft tissue management, and femoral component positioning based on the tibial axis.

SIGNIFICANCE: Patella related complications remain a major concern and have frequently caused secondary intervention, independent whether resurfaced or not. Common modes of failures are increased polyethylene wear, bearing fractures, component dissociation (loosening of metal component and spinout of bearing) and patella fractures. Reports in the literature are frequently non-specific regarding surgical approach, femoral rotation alignment, and femoral design features, which are frequently non-anatomic and "patella unfriendly". Current femoral designs are becoming more anatomic and compatible for patella retention in TKA.

140. THE ROLE OF COMPONENT ROTATION ON THE PATELLOFEMORAL ALIGNMENT IN MOBILE BEARING TOTAL KNEE ARTHROPLASTY WITHOUT PATELLAR RESURFACING. ***Jaehoon Chung, MD****; Ilsung Park, MD*

Mobile bearing total knee arthroplasty (LCS) may be suitable for patellar retention because it has anatomical femoral groove. The purpose of this study is to establish the effect that component rotation has on the patellofemoral alignment in mobile bearing total knee arthroplasty without patellar resurfacing.

Component rotation was measured in 74 total knee arthroplasties using computed tomography and patellofemoral alignment defined by evaluating the congruence angle on Merchant's view. ANOVA test was used for the statistical analysis.

Mean congruence angle was 24.2±23.7 degrees. 73 knees (98.6%) showed internal rotation of the femoral component (mean, 6.7±3.9°). Internal rotation of the tibial component was noted in 34 knees. 4 groups were categorized; 15 knees with no internal rotation of the tibial component and internal rotation of less than 5 degrees of the femoral component as Group 1; 25 knees with normal tibial rotation and more than 5 degrees of femoral rotation as group 2; 17 knees with tibial rotation and less than 5 degrees of femoral rotation as group 3 and 17 knees with tibial rotation and more than 5 degrees of the femoral rotation as group 4. Mean congruence angle was 8.3±30.7 degrees, 30.9±18.8 degrees, 29.8±14.4 degrees and 22.8±25.5 degrees for group 1, 2, 3 and 4, respectively ($p=0.017$).

In conclusion, the patellofemoral alignment was best in knee joints with normal or minimal rotation of both components and worse in joints with single component rotation rather than with both component rotation.

141. RADIOGRAPHIC MEASUREMENT OF THE PATELLA TILT AND ROTATIONAL ALIGNMENT OF THE FEMORAL COMPONENT IN TOTAL KNEE ARTHROPLASTY. ***Nobuyuki Yoshino, MD****; Shinro Takai, MD; Yasusuke Hirasawa, MD*

PURPOSE: Rotational alignment of the femoral component is well understood to influence on the patellar tracking. Assessment of rotational alignment of the femoral component onto the femoral condyle has been quite difficult radiographically without CT or MRI. The purpose of this study was to assess the rotational alignment of the femoral component to the transepicondylar axis (TEA) using plane radiographic technique.

MATERIALS AND METHODS: The study population consisted of 30 patients with 33 knees (average age: 68.4) who underwent primary TKA. All patients were evaluated radiographically before and after surgery using a new technique, which is a postero-anterior projection vertical to the tibia at 70 to 80° flexion of the knee and can represent TEA and posterior condylar line (PCL). Rotational angle of the femoral component to the TEA was measured. The 30° skyline view was also obtained. The congruity of the postoperative patellofemoral joint was evaluated using Gomes's method.

RESULTS: The posterior condylar angle between TEA and PCL was 5.7±1.6° preoperatively and 2.6±0.9° postoperatively. The femoral component was shown to be 3.2±1.1° externally rotated. Tilting angle of the patella correlated with the rotational angle of the femoral component to the TEA.

CONCLUSIONS & SIGNIFICANCE: Malrotational placement of the femoral component has been shown to result in the patellar tilt using CT, not plane radiographic technique. We conclude that the radiographic technique employed in this study may be beneficial to assess both rotational placement of the femoral component and wear of the tibia insert.

142. OPEN REDUCTION AND INTERNAL FIXATION OF 111 MONO- AND BICONDYLAR TIBIAL PLATEAU FRACTURES. A 13-YEAR FOLLOW-UP STUDY. ***Gino M.M.J. Kerkhoffs, MD*** *(a – Academic Medical Center, Dept. of Ortho. Surg.); Maarten Rademakers, M.Sc.; Ernst L.F.B. Raaymakers, MD, PhD; Rene K. Marti, MD, PhD; Frank van Bommel, MD*

Purpose: Evaluation of the functional and radiological outcome of osteosynthesis of mono- and bicondylar tibial plateau fractures.

Method: One-hundred and eleven patients with an operated mono- or bicondylar fracture were included in the study. Eighty-six of these were seen at our clinic at a recent follow-up, nine were interviewed by telephone, sixteen patients had died. At follow-up physical examination and radiographic evaluation was performed, and the Neer score and the HSS knee score were evaluated. The mean age at follow-up was 56 years. The average follow-up period was 13 years (range 5 to 23 years). Twenty fractures were bicondylar. T or L-plates were used in 49, screws in 37 patients.

Results: Seventy-nine patients (91%) had a good or excellent result on the Neer score, and seventy-six patients (88%) had a good or excellent result on the HSS knee score. Twenty-seven patients (25%) developed osteoarthritis (grade 2 or 3 according to Ahlback). Interestingly, 22 of these patients (81%) had a good or excellent functional result. Patient satisfaction at the latest follow-up was 96% (n=91). There is no significant correlation between fracture type and the development of osteoarthritis (p=0.7), nor between the type of internal fixation and development of osteoarthritis (p=0.6).

Conclusion and Significance: We achieve excellent long-term results with ORIF of mono- and bicondylar fractures (96% patients satisfied). Although there is a high percentage of osteoarthritis after the use of osteosynthesis, these patients tolerate this late complication well.

143. TOTAL KNEE ARTHROPLASTY AFTER FAILED HIGH TIBIAL OSTEOTOMY. *R. Badet;* ***T.A.S. Selmi****; Ph. Neyret; P. Chambat*

Introduction: A significant number of patients require Total Knee Arthroplasty (TKA) after High Tibial Osteotomy (HTO). The authors assessed the technical difficulties and the effect of HTO on the results of a subsequent TKA.

Material and method: 90 TKA were performed on 86 patients who had had a previous HTO. 81% were reviewed at an average follow-up period of 6.5 years (2-15 years). The average delay from HTO to TKA was 11.8 years. Patients were evaluated clinically (IKS score) and radiographically.

Results: At follow-up the average knee score was 82.5/100 (36.5 pre-op). We noted an improvement in range of motion (3-98° to 1-108°) and relief of pain (11/50 to 39/50). Medio-lateral instability was inferior to 5 mm in 90.5%. The average functional score was 62/10 (48 pre-op). Radiographically, the value of the femoro-tibial mechanical angle was 179.2° ± 4. A patella infera was found in 43.3% cases. Radiolucent line was observed in 21% of cases no mechanical loosening were observed. The survival curve for TKA was 90 ± 5% at 10 years.

Discussion and Conclusion: The results in the TKA after HTO were almost similar to the results reports in the literature after arthroplasty in knee without prior HTO. However the relief of pain and knee function were inferior. We discuss the technical difficulties due to malunion related to HTO.

Exceptionally, in severe malunion (superior to 9°) we proposed an osteotomy combined to TKA. The possibility of subsequent TKA must be taken into account when we decide indication and technical option in HTO.

144. MORTON'S NEUROMA IN ATHLETES: A RETROSPECTIVE, COMPARATIVE, 2-5 YEAR FOLLOW-UP STUDY OF PLANTAR VERSUS DORSAL INCISIONS. ***Christian Akermark, MD****; Hans Crone, MD; Tonu Saartok, MD, PhD; Zbigniew Zuber, MD*

Objective: The purpose of this study was to compare the results of plantar versus dorsal incisions in the excisions of neuromas in patients, participating in recreational or athletic activities.

Material and Methods: Seventy-seven consecutively operated patients, from two orthopaedic centers were followed-up. Excisions of neuromas were performed by two equally experienced surgeons. In Center A (CA) a plantar incision was performed in 42 patients / 45 feet and in Center B (HC) a dorsal incision was performed in 35 patients / 38 feet. There were 62 women and 15 men. At follow-up, a physical examination was performed and a questionnaire evaluated by one of two independent orthopaedic surgeons TS and ZZ).

Results: Histology revealed positive neuromas in all but one case (Center B). There was a significant difference between the centers, regarding limitations in patients recreational or athletic activities, but not in their daily activities. Three patients were reoperated in Center A (incisional problems) and 3 patients in Center B (two recurrent neuromas and one missed nervresection). The overall results were considered excellent or good in 86% (39/45 feet) in Center A and in 74% (30/38 feet) in Center B (n.s.), whereas the corresponding figures for patients participating in athletic activities showed a significant difference, 95% (21/22 feet) in Center A and 63% (10/16 feet) in Center B.

Conclusions: The two surgical approaches were comparable , regarding patient's outcome in daily activities but in more demanding athletic activities, such as running and aerobics, the plantar incision seems to be a preferable approach.

146. KNEE JOINT VIBRATION ANALYSIS. ***Mark E. Gittins, DO****; Jeffrey E. Gittins, DO; Carl Berasi, DO; Richard Herzog, MD*

Introduction: A visual interpretation method of joint vibrations has been developed. Introductory research has shown that different vibrations occur with various types of knee pathology. The purpose of this study is to compare the results of arthroscopic surgery, magnetic resonance imaging, and non-invasive joint vibration analysis in the diagnosis of meniscal tears.

Methods: We prospectively tested sixty-three symptomatic knees. The inclusion criteria consisted of patient consent, knee range of motion from at least 0-90 degrees, and adequate mental competence. Patients were excluded who had previous knee surgery, fracture, trauma, or were unable to follow directions.

Joint vibration recordings are taken only of the symptomatic knee. Vibration sensors are placed on the anterior surface of the patella, the medial joint line, and the lateral joint line. An electronic goniometer is utilized to record the knee angle. Three activities are performed for at least six cycles. These included 1) unloaded free leg swing from full

extension to 90 degrees, 2) fully loaded partial knee bend to 60 degrees from full extension, and 3) fully loaded six inch step-up from 60 degrees of flexion. A single, fellowship trained musculoskeletal radiologist interpreted all magnetic resonance images. The arthroscopic surgical reports of two surgeons, who are members of the Arthroscopy Association of North America, are used as the gold standard in evaluation of knee pathology.

Results: The 63 patients were reviewed. A specificity of 100%, sensitivity of 71% and positive predictive value of 100% for medial tears were found using JVA. MRI had a positive predictive value of 90% and specificity of 88%, and sensitivity of 74% for medial tears. JVA had a specificity of 92%, sensitivity of 67% and positive predictive value of 84% for lateral tears. MRI had a specificity of 90%, a sensitivity of 75% and a positive predictive value of 85% for lateral tears.

Conclusion: Based on the initial findings of Joint Vibration Analysis compared to MRI and arthroscopy, JVA appears to offer the clinician an alternative method to diagnose meniscal tears. The advantages of a cost effective, in-office tool to aid in the diagnosis of meniscal tears is encouraging. Further research with Joint Vibration Analysis is warranted.

147. COMPARISON OF THE LOCAL AND GENERAL FATIGUE EFFECTS TO KNEE PROPRIOCEPTIVE FUNCTION. ***Kazutomo Miura****; Yoshihisa Okamura; Yasuyuki Ishibashi; Eiichi Tsuda*

OBJECTIVE: Errors of motor performance of athletes occur more frequently during fatigue, but it is not known whether this is due to impaired proprioception or to other factors. Fatigue may decrease proprioceptive afferent signals from mechanoreceptors in and around muscles and make the knee less sensitive to potentially damaging force. The results of past study about proprioceptional changes after fatigue were not consistent because of different methods to induce fatigue. The purpose of this study was to compare the local and general fatigue loads effects to knee joint proprioception.

METHODS: Proprioception of the knee joint was measured by reproductive angle inaccuracy (RAI) which was calculated as the mean values of the absolute error in eight consecutive trials between passively positioned knee angle (randomly selected in 10 to 80 degree) and actively reproduced knee angle.

The RAI of the knee joint before and after two different types of fatigue loading (local and general load) was measured in twenty-seven healthy volunteers (males, ranged from 19 to 31, averaged 22.2 years). Local load to the knee was 60 consecutive voluntary maximum concentric contractions of the knee flexors and extensors on the isokinetic dynamometer. General load was 5 minutes running at 10 km/h on a treadmill. The changes of RAI, peak torque of knee flexors and extensors, and heart rate were statistically compared between local load and general load using One-factor ANOVA. The level of significance was set at $p = 0.05$.

RESULTS: After local load to the knee, there were no changes in RAI (mean $\pm$ standard deviation $= 3.8 \pm 1.1$ (in degrees)) than before loading (3.4 ± 0.9), although significant decrease of peak torque of knee flexors and extensors was seen. In contrast, after general load, a significant increase of RAI was noted (5.1 ± 2.1) ($P<0.05$) without significant changes in peak torque of them.

CONCLUSIONS: Decreased reproduction ability after general load is presumably not through the loss of peripheral proprioceptive afferent signals, but through deficiency of central processing of proprioceptive signals, that is, central fatigue. Central fatigue may diminish precision of motor control, interrupt voluntary muscle-stabilizing activity to resist imparted joint forces, and possibly put the knee at risk for Anterior Cruciate Ligament injury at last.

148. THE EFFECT OF GENDER ON KNEE LAXITY AFTER ACL RECONSTRUCTION. ***Shinya Nagasaki, MD****; Yasumitsu Ohkoshi, MD, PhD; Kazuki Yamamoto, MD; Shigeru Yamane, PhD*

PURPOSE: Hormonal influences are known to play a role in increased knee laxity in healthy women. However, no studies have examined whether the gender influences the knee laxity after ACL reconstruction. The purpose of this study was to determine whether there is a difference in anterior laxity between males and females who undergo ACL reconstruction.

METHOD: Between April 1992 and March 2000, a single surgeon performed ACL reconstruction on 498 knees using hamstring tendons. All patients followed the same rehabilitation protocol. Patients in whom the anterior laxity was able to be measured one year postoperatively were included in this study. The exclusion criteria of this study were: (1) over 40 years old, (2) combined ligament injuries which required reconstruction, (3) bilateral injuries, (4) former knee operations, and (5) a passive motion deficit at follow-up. Consequently, 208 patients, 86 males (group M) and 122 females (group F), were included in this study. The anterior tibial translation was measured with a KT-1000 arthrometer (manual maximum load), and the side-to-side difference was compared between the two groups. The background factors (age, graft size/body weight, number of the meniscal lesions and pre-operative period) were also compared between the two groups. Statistical testing was performed using the two-way ANOVA test, unpaired t test, chi-square test, Pearson's correlation coefficient, and power analysis.

RESULTS: The mean side-to-side difference in the anterior laxity was 2.10 ± 1.92 mm in group F and 1.47 ± 1.84 mm in group M ($P=0.047$). The investigated background factors showed no differences between the two groups.

CONCLUSION: Our results show that the anterior knee laxity after ACL reconstruction was different between the males and females. We postulate that hormonal differences played a role in this finding.

149. THE GASTROCNEMIUS IS AN ANTAGONIST OF THE ANTERIOR CRUCIATE LIGAMENT. ***Braden C. Fleming, PhD*** *(a – dj Orthopaedics LLC); Per Renström, MD, PhD; Goran Ohlen, MD; Bruce D. Beynnon, PhD*

Objective: The primary muscles that span the knee are the quadriceps, hamstrings and gastrocnemius. The effects that the quadriceps and hamstrings have on ACL strains are well documented. However, the influence of the gastrocnemius muscle remains controversial. Since the gastrocnemius wraps around the posterior aspect of the tibial plateau, its contraction could potentially strain the ACL by pushing the tibia anterior when the knee is near extension. The objective of this study was to determine if the gastrocnemius muscle is an antagonist of the ACL.

Methods: Six subjects who were candidates for arthroscopic meniscectomy participated in the study. The study received Institutional Review Board approval and all subjects granted their informed consent. The surgery was performed under spinal anesthesia to ensure that all of the leg musculature was relaxed. Transcutaneous electrical muscle stimulation was used to induce contractions in the gastrocnemius using 2" x 4" oval electrodes placed across the belly of the muscle (CPS 400 Stim; Chattanooga Group, Hixson, TN). Following the routine surgical procedure, a Differential Variable Reluctance Transducer (DVRT; MicroStrain, Inc., Burlington, VT) was implanted on the ACL to measure strain. During testing, the thigh was constrained in the horizontal plane

and the foot was positioned in a fixture that controlled the knee and ankle positions. The fixture incorporated a 6-DOF load cell (SRMC3A; AMTI, Watertown, MA) to measure the plantar-flexion moments generated at the ankle due to the induced gastrocnemius contraction. The gastrocnemius was electrically stimulated with the knee at 5°, 15°, 30° and 45° of flexion (randomized). The foot was constrained with the ankle in the neutral position (0° plantar-flexion). Electrical muscle stimulation was applied to produce ankle moments of 15 Nm (a 2-second ramp). It should be noted that a gastrocnemius force of 250 N would be produced by a 15 Nm ankle plantar flexor moment if we assume a moment arm of 6 cm. The effects of knee flexion angle and gastrocnemius force magnitude on ACL strain values were statistically analyzed using an analysis of variance (factorial complete block design). Each person served as his/her own control.

Results: Both knee flexion angle ($p<0.01$) and gastrocnemius force ($p<0.01$) affected ACL strain values. With the knee at 5° and 15° of flexion, contraction of the gastrocnemius produced mean ACL strain values (+/- the 95% confidence interval) of 2.8 (1.2)% and 3.5 (0.6)%, respectively. At the higher knee flexion angles (30° and 45°), the ACL was not strained.

Conclusions and Significance: This study supported our hypothesis that the gastrocnemius muscle was an antagonist of the ACL when the knee was ear extension. Our results may have important clinical ramifications in ACL rehabilitation since flexor moments are usually associated with hamstrings activity and hence are generally thought to be protective of the ACL. Since the gastrocnemius muscle can also contribute to the flexor moment at the knee, this premise may not always be valid.

Acknowledgment: *The experiment was performed at the Karolinska Hospital, Stockholm Sweden. This study was funded by a grant from the National Football League. We also thank the Chattanooga Group (Hixson TN) for loaning us the electrical muscle stimulation machine.

150. BPTB AND HAMSTRING TENDONS TECHNIQUE IN AUTOLOGOUS ACL RECONSTRUCTION – INFLUENCES ON POSTOPERATIVE REHABILITATION.

***Artur Pasierbinski, PT**; Robert Smigielski, MD; Aneta Jarzabek, PT; Grzegorz Adamczyk, MD, PhD*

PURPOSE: Comparison of postoperative rehabilitation in two groups of patients after ACL reconstruction using different technique.

MATERIAL & METHOD: In last two years in our clinic 157 patients undergone ACL reconstruction. 76 male 81 female in the age from 16 to 59 years old (mean 34). Patients had different pre injury level of activity, from light recreation to professional sport. In 55 cases BPTB and in 102 cases hamstrings tendon technique have been used. Principles of postoperative care and rehabilitation for both groups of patients were the same. Control of pain, swelling and inflammation. Full weight bearing as tolerated with or without crutches. Immediate ROM exercises in the range 0°- 60° to 90° as tolerated, gradually increased to 120° and full flexion after 4 - 8 weeks postoperatively. Quadriceps, hamstrings and whole lower limb and pelvis muscle exercises with increasing resistance in closed and open kinetic chains. Prevention from patello-femoral joint problems. Proprioception and co-ordination exercises (from early postoperative). Return to work after 2 - 4 weeks, recreation and sports activity after 4, 6, 9 months.

RESULTS: We noticed that during rehabilitation most of the patient from Hm tendon group had tendency to externally rotate tibia in gait and during CKC and OKC exercises like squats, cycling and active flexion. It was visible specially between women and low level activity patients. In rehabilitation too early hamstrings and adductors muscles strength and stretching exercises, and cocontraction of hamstrings may lead to pain of the medial side of the knee and tight, and change the movement patterns of lower limb. That's why we start OCK hamstrings exercises after 6 weeks, and from early postoperative we utilise ice massage and manual stretching of hamstrings and adductors. Patients from Hm tendon group comparing to BPTB group more easy achieved normal patellar mobility, passive extension and flexion of the knee, but it took longer time to restore full active flexion and strength of hamstrings muscle.

CONCLUSION: There were no significant differences between two groups in strength and stability at the time of returning to sport or recreational activity, but in Hm tendon group there were much less causes of anterior knee pain, and patello-femoral joint problems.

151. THE EFFECT OF DIFFERENT REHABILITATION PROTOCOLS ON TIBIAL TUNNEL WIDENING AFTER ACL RECONSTRUCTION WITH HAMSTRINGS.

***Hans H. Paessler**; Michael Hantes; Dimitrios Mastrokalos; Jiakuo Yu*

Introduction: It has been hypothesized that aggressive rehabilitation protocol is a factor associated with bone tunnel enlargement after ACL reconstruction. The purpose of this study was to evaluate the influence of different rehabilitation protocols (accelerated vs. non-accelerated) on tibial tunnel enlargement in patients who underwent ACL reconstruction with hamstring autograft.

Methods: Two groups of patients were evaluated. Group A: Isolated ACL reconstruction in 35 pts (19 male, 16 female; mean age 37.2, 10.8) with an early aggressive rehabilitation (eleven patients in this group had a previous meniscectomy). Group B: combined meniscal repair and ACL reconstruction in 20 pts (11 male, 9 female; mean age 32.3, 10.2). Partial weight bearing and restriction of ROM (0-90°) for 6 weeks was recommended to these patients. Grafts were secured in place with an implant free press-fit technique. Patients were evaluated clinically (IKDC, KT-1000) and radiographically (AP and L view) at 3, 6 and 12 months postop. After scanning and correction for radiographic magnification, the tibial tunnel was measured at proximal (T3), middle (T2) and distal (T1) locations on both AP and L view, using a special software (Scion Image).

Results: At 1 year follow-up, there was significantly more tunnel widening in Group A.

	T1(AP) %dif.	T1(L) %dif.	T2(AP) %dif.	T2(L) %dif.	T3(AP) %dif.	T3(L) %dif.
Group A	24.5114.17	26.3914	45.9233.28	48.1430.26	36.1418.06	36.6418.06
Group B	18.4411.61	14.110.22	23.348.14	23.357.68	21.3111.16	24.4910.86
P value	0.175	0.006	0.02	0.006	0.028	0.026

No statistical relationship was found between tunnel widening and clinical results (stability, ROM, IKDC). Gender, age (patients younger than 35 years vs older), acute vs chronic reconstruction (limit 2 months) or previous meniscectomy had no influence on tunnel widening.

Conclusion: To our knowledge this is the first study which confirms that micromotion during the period of tendon healing (8 to 12 weeks) may be an important factor for tunnel widening after ACL reconstruction with hamstrings. This may have an impact on future rehabilitation protocols.

152. THE ACL STRAIN RESPONSE DURING THE LEG PRESS EXERCISE.

***Per Renström**; Braden Fleming (a – dj Orthopaedics LLC); Goran Ohlen; Tonu Saartok*

Objective: Our objective was to evaluate changes in ACL strain values that occur during the leg press exercise with an increase in load.

The leg press exercise is a "closed kinetic chain" (CKC) activity that is commonly prescribed following ACL surgery. CKC exercises are thought to be protective of the ACL since they utilize co-contraction of the knee flexor muscles and the compressive load produced by body-weight to reduce anterior translation of the tibia with respect to the femur. The effect of increasing resistance during CKC exercises on ACL strain biomechanics has not been previously studied in a systematic fashion.

Methods: Seven patients who were candidates for arthroscopic meniscectomy under local anesthesia participated in the study. Other than the meniscal lesion, all subjects demonstrated normal knee joint function. The study was approved by the Institutional Review Board and all subjects granted their informed consent. ACL strains were measured using the Differential Variable Reluctance Transducer (DVRT, MicroStrain, Inc., Burlington, VT). Following the routine surgery, the DVRT was arthroscopically inserted on the ACL and the subject was seated on a commercial leg press machine. Limb position was standardized by placing the subject's feet on the foot pedal of the leg press machine to orient the center of the calcaneus with the hip joint in the horizontal plane. Each subject was instructed to extend their legs from a flexed position to lift a stack of weights. Three load values were tested, 0, 40 and 80% of the subject's body weight. The testing order was randomized. It was assumed that each subject shared the load equally between both legs. For each loading condition, the subject performed three flexion-extension cycles. ACL strain values across the three loading cycles were ensemble averaged and then compared from 80° to 15° of extension at 10° increments using an analysis of variance for repeated measures. Full extension was avoided to prevent impingement of the DVRT within the knee. Each subject served as their own control.

Results: On average (+/- 1 std. error), the peak ACL strain values were 3.9 (+/-1.5)%, 3.4 (1.6)%, and 2.9 (1.8)% for the 0%, 40% and 80% of body weight load conditions, respectively. Peak ACL strain values occurred when the knee reached 15° of extension. No significant differences in ACL strain values were found between the three loading conditions at any knee flexion angle tested ($p<0.46$).

Conclusions and Significance: We have previously shown that the ACL strain values produced during the simple squat were similar in magnitude to those produced during active extension exercises. This led us to believe that the strains produced during a CKC activity were similar to those produced during an "open kinetic chain" (OKC) exercise and questioned the use of the OKC and CKC designations for determining if an exercise is safe or unsafe for the rehabilitation of the ACL or healing ACL graft. However, the current study suggests that increasing resistance during a CKC exercise to increase muscle activity about the knee will not increase ACL strain values unlike OKC exercises. This suggests that there may be a potential benefit for the CKC activities.

Acknowledgment: *The experiment was performed in collaboration with the Dept. of Orthopaedics, University of Vermont. This study was funded by the National Football League Charities.

153. KINEMATIC PATTERNS BEFORE AND AFTER ACL RECONSTRUCTION. *Anastasios Papadonikolakis; Anastasios Georgoulis;* ***Christos Papageorgiou****; Ulf Moebius*

OBJECTIVE: The aim of this study was to evaluate the kinematics before and after ACL reconstruction using a BPTB autologous graft.

METHODS: Ten patients (2 F and 8 M, age 26±5 yrs) with ACL deficient knees and nine patients (1 F and 8 M, age 25±4 yrs) with ACL-reconstructed knees were analyzed during walking in a 10 meter walkway at a freely selected pace. Ten healthy subjects age, height and weight matched were selected as controls.

3-D (Peak Performance system, 50 Hz) kinematics were collected from both lower limbs of all subjects. One way ANOVAs were performed on kinematic parameters selected from the existing literature. A Tukey test was performed in comparisons that resulted in a significant F-ratio ($p<0.05$).

RESULTS: The ACL deficient subjects had, during initial swing phase, an internal tibial rotation of 8.74±9.19 in contrast to healthy and ACL reconstructed subjects with external tibial rotations of 3.53± 6.22 and 1.96±9.11 respectively. During the stance phase ACL deficient patients had lesser flexion than healthy subjects although the difference was not statistically significant.

CONCLUSIONS AND SIGNIFICANCE: ACL deficient patients tend to go into more extension during the stance phase. Displacement of the center of knee joint rotation may explain the internal rotation occurring during the initial swing phase in these patients. After reconstruction of the ACL, the knee joint rotation center is restored and the patients have an external rotation similar to healthy subjects. Further investigation is required to clarify the clinical significance of this finding, however.

154. INDUCTION OF SOMATOSENSORY EVOKED POTENTIALS BY MECHANICAL STIMULATION IN RECONSTRUCTED HUMAN ANTERIOR CRUCIATE LIGAMENTS. ***Mitsuo Ochi, MD, PhD;*** *Junji Iwasa, MD; Yuji Uchio, MD, PhD; Kenzo Kawasaki, MD*

PURPOSE: To determine whether regenerated nerve fibers and mechanoreceptors in the reconstructed human anterior cruciate ligament (ACL) can respond to mechanical loads applied to the ligament and can elicit reproducible somatosensory evoked potentials (SEPs).

METHODS: Injured, reconstructed, and normal ACLs were mechanically stimulated during arthroscopy under general anesthesia (200 stimuli, force: 3.92 newtons, rate: 2/s). All patients provided informed consent for this study. In reconstructed knees, pre- and postoperative position sense and knee stability were also measured, and their relationship to the voltage of the SEPs was determined using one-way ANOVA or unpaired t test.

RESULTS: Reproducible SEPs were detected in all normal ACLs (19/19), in 36 of 38 ACLs reconstructed over the past 13 months, and in 26 of 45 deficient ACLs. The mean side-to-side difference in anterior displacement in the SEP-positive group (26) was significantly lower than that in the SEP-negative group (19) (4.07 ± 1.59 mm vs. 5.81 ± 2.40 mm; $p=0.002$). In the reconstructed group, neither the voltage nor the position sense differed significantly between the stable knees (32) and the unstable knees (8). However, in this group, the postoperative position sense was significantly better than the preoperative position sense (0.48 ± 1.42° vs. 1.01 ± 0.86°; $p=0.03$).

CONCLUSIONS AND SIGNIFICANCE: Our results indicate not only that sensory re-innervation occurred in the reconstructed human ACL but also that the sensory function of reacting to mechanical loads can be restored and is strongly related to improvement in the position sense.

155. ARTHROSCOPIC REPAIR IN ACUTE TRAUMATIC ANTERIOR SHOULDER DISLOCATION IN YOUNG ATHLETES. ***Mario Victor Larrain, MD****; Guillermo Botto, MD; Hugo Montenegro, MD; David Mauas, MD; Cristian Collazo, MD*

Purpose: To compare the results of arthroscopic repair in acute anterior shoulder traumatic dislocation with nonoperative treatment.

Type of Study: A Prospective Non-Randomized Study was performed.

Materials and Methods: 46 patients were seen after a first episode of traumatic anterior shoulder dislocation between August '89 and April '97. The average age was 21 years old (range 17-27). Most dislocations were in rugby players (36 patients). 18 patients were treated by nonoperative methods. 28 patients were treated by acute arthroscopic repair, 22 using transglenoid suture, and 6 patients with a bone anchor suture technique fixation.

Results: 94.5% of the patients treated nonoperatively suffered a redislocation between 4 and 18 months (average 6 months). In the operative group 96% of the patients (27) obtained excellent results (Rowe scale). Only 1 patient suffered a redislocation one year following surgery. Three different types of lesions were found during surgery, group I: capsular tear with no labrum lesion (4%), group II: capsular tear with partial labrum detachment (32%), group III: capsular tear and full anterior labrum detachment (64%). The average follow-up was 67.4 months (range 28-120). There were no surgical complications.

Conclusions: The operative group obtained 96% excellent results, meanwhile the nonoperative group only obtained 5.5% excellent results according to the Rowe scale. The non operative group showed a high incidence of redislocation (94.5%) compared to the incidence in the operative group (4%). Based on the findings of this study, we recommend using an arthroscopic evaluation and repair after an initial anterior traumatic shoulder dislocation in young athletes.

156. THE RESULTS OF OPEN RECONSTRUCTIVE SURGERY AND ARTHROSCOPIC BANKART REPAIR FOR RECURRENT ANTERIOR DISLOCATIONS OF THE SHOULDER. A COMPARATIVE STUDY ON 206 SHOULDERS. ***Gavriel Mozes****; Gabriel Agar; Ron Arbel*

Introduction: The increasing use of arthroscopic surgery for recurrent anterior shoulder dislocations (RASD) has raised skepticism from surgeons using open techniques. Very few papers were found in the medical literature dealing with a comparative study between open and arthroscopic surgery in the treatment of this condition. In this paper a retrospective comparative study dealing with the two surgical techniques, open and arthroscopic, performed by the same operating team is presented.

Patients and Methods: Between September 1990 and September 1997, 110 patients suffering from recurrent anterior dislocations were treated by antero-inferior capsular shift which is a T plasty on the glenoid site on the antero-inferior capsule, and the Boytchev procedure. In the beginning, the patients were randomly selected for these specific methods of treatment, but after the first 82 cases, directed by the results, only the capsular shift procedure was used in the remaining 28 cases. Seven patients were lost to the follow-up, 5 of them treated by the Boytchev method. Out of the 103 patients followed, 67 were treated by capsular shift and 36 by the Boytchev technique.

The use the arthroscopic surgery for RASD stabilization began in January 1995. Between January 1995 and May 1999, 95 patients, 103 shoulders, were managed with an Arthroscopic Bankart Repair (ABR) and/or Arthroscopic Capsular Shift (ACS). In the first two years, in 25 cases the Suretac (Suretac group), an absorbable canalled polygliconate tack was used. Because of the relatively high recurrence rates, the technique and anchors were changed. In the next 14 cases Mini-Revo and OBL anchors using a suture passer to place sutures into the detached labrum (AIGHL or anterior capsule), started to be implanted. This 39 cases formed the "learning curve group." In the last 64 cases, a single anterior portal technique applying biodegradable Panalok anchors and PDS sutures, was utilized. This group of 64 shoulders formed the "Panalok group."

Results: A 97% success rate regarding reoccurrence was found in the open reconstructive surgery group, but also a relatively high complication rate was found: five (5%) transient Musculo-Cutaneous nerve palsy (all of them from the Boytchev group - 13.8%), a case with superficial wound infection, and two patients who underwent arthroscopic Bankart repair after traumatic recurrent anterior dislocation. In addition, two cases of Reflex Sympathetic Dystrophy were found and three patients underwent arthroscopic subacromial decompression due to impingement syndrome. In the Suretac group, an 88% success rate was encountered regarding reoccurrence; the postoperative rehabilitation was easier, and the postoperative external rotation was less than after open surgery. In the Panalok group, two recurrences and two cases of chronic impingement syndrome were encountered. The impingement syndromes became evident only after the patients gained a full range of motion of the shoulder joint.

Conclusions: Arthroscopic suture of the labrum to an anchor implanted into the anterior glenoid is an effective and safe modality in the management of the unstable shoulder and should be recommended. Regarding reoccurrence, in spite of the short follow-up, one can predict as good results with arthroscopic surgery as with open surgery. In the arthroscopic surgery group, the postoperative rehabilitation was easier, and no limitation of movements was observed.

157. LOCKED POSTERIOR SHOULDER DISLOCATION – SURGICAL TREATMENT. ***Antonio Delcogliano****; Salvatore Franzese; Antonio Caporaso; Silvio Chiossi*

Posterior shoulder dislocation (PSD) is an unusual lesion ($< 5\%$ of whole dislocations) and often misdiagnosed (50-80% of PIDS).

Aim: Clinical and radiographic evaluation at 2 years mean follow-up of nine patients with locked PIDS treated surgically.

Materials and methods: Nine patients were treated between 1996 and 1998 for locked PIDS. The correct diagnosis had been missed in all cases at the first evaluation and made at mean 5 months after injury. All patients were subjected to standard x-rays including axillary view and a CT scan evaluation was also performed pre-operatively and 1 year after surgery. Anterior head lesion was $< 30\%$ in six patients, in two patients was $> 30\%$ of joint surface; in one patients the defect outgrowth 40%. In 2 patients we performed the subscapolaris tendon transposition (McLaughin procedure), in six patients lesser tuberosity transposition was performed (McLaughin modified by Neer). In the patient with humeral head lesion more than 40% we performed a coracoid with inserted bicipital tendon transfer onto the bone lesion. The patients were evaluated 2 years after surgery radiographically and clinically (Constant score system and Simple shoulder test).

Results: At two years the patients were subjectively satisfied. No avascular necrosis, new dislocation or heavy osteoarthritis was reported in our series. All patients had a light limitation during abduction and elevation of affected arm, extrarotation was always reduced 10 to 30°. In the patient in which had been made coracoid transfer the subject complained of mild shoulder pain during activity.

Conclusion: McLaughin procedure and coracoid transfer are safe and predictable procedures and can be recommended in chronic PIDS treatment. Coracoid with bicipital tendon transfer should be a good treatment option if the humeral head defect is $> 40\%$ of joint surface and we want to avoid hemiarthplasty.

158. SHOULDER INSTABILITY OF YOUNG SPORTSMEN IN CONTACT SPORTS. IS IT JUST TRAUMA? FINDINGS AND RESULTS OF ARTHROSCOPIC TREATMENT. ***Daniel Slullitel, MD****; Miguel Slullitel, MD*

Object: Evaluation of shoulder instability type detected and arthroscopic treatment results on young sportsmen, average age being 21 years old and playing contact sports.

Method: 30 sportsmen averaging 21 years old were assessed, 28 of them were rugby players and the other 2 basketball players, their clinical and in-surgery records were also used to identify the sort of instability. All of them were operated on by arthroscopic method, 10 of them received anterior capsular plication with transglenoid suture not involving the labrum and other 20 underwent anterior capsular suture, closure of the rotator interval and a posterior capsular plication with screwing, focusing on achieving retightening of the posterior arm of the inferior glenohumeral ligament. In those cases where laxity was not corrected, radio frequency therapy was applied.

Results: 30% of patients showed laxity on their contralateral shoulder and 20% had a family record showing such a condition. All these patients demonstrated a redundant posterior capsule in their magnetic resonance with gadolinium. Consequently, although they may have suffered a trauma triggering the condition, they already had a related underlying multidirectional laxity.

As regards to the arthroscopic treatment effects, there have been 3 recurrences. All of which occurred in the group that received isolated anterior capsular suture and none in the group of anterior/posterior capsular plication with closure of rotator interval – with the exception that there are 10 cases of the latter group having an evolution period ranging from 12 to 24 months.

Conclusion and Significance: One of the reasons accounting for the treatment failure on young sportsmen and contact sports lies upon an underestimation of the global laxity and overestimation of the macro trauma, usual in this kind of sports. If we are aggressive in this laxity correction, arthroscopic treatment may produce the same successful effect as the open method.

159. UNBIASED EVALUATION OF THE ARTHROSCOPIC EXTRA-ARTICULAR TECHNIQUE FOR BANKART REPAIR. A CLINICAL AND RADIOGRAPHIC STUDY WITH A TWO- TO FIVE-YEAR FOLLOW-UP.

***Jüri Kartus**; Catarina Kartus; Paul Povacz; Rosemarie Forstner; Lars Ejerhed; Herbert Resch*

Purpose: To perform an unbiased clinical re-examination of patients who a minimum of two years previously had undergone an arthroscopic extra-articular Bankart repair using Suretac® fixators. Furthermore, to prospectively evaluate the development of degenerative changes in the shoulder using standard radiographs.

Methods: Eighty patients with post-traumatic recurrent anterior shoulder dislocations were included in the study. Two unbiased observers who had never seen the patients before and had in no way been involved in the treatment of the patients were given unlimited access to the patients' files, surgical reports and radiographs.

Results: Seventy-two/80 (90%) patients attended the follow-up 42.5 (24-66) months after the index procedure. Failures in terms of stability (redislocations and subluxations) were registered in 14% of the patients. The Rowe score was 97 (51-100) points. The Constant score was 94 (56-100) and 97 (80-100) points for the injured and non-injured shoulders respectively ($p=0.002$). A return to the preinjury level of activity was registered among 49/67 (73%) of the patients. There was a significant increase in degenerative changes between the pre- and postoperative radiographic assessments ($p<0.0001$). At the follow-up the drill holes after implanting the Suretac® fixators were classified as invisible or hardly visible in 62/70 (89%) patients.

Conclusion: At the two- to five-year follow-up, the extra-articular arthroscopic Bankart repair using Suretac® fixators resulted in stable and well-functioning shoulders in a high proportion of patients. However, the signs of radiographic degenerative changes increased between the preoperative assessments and the two- to five-year follow-up.

160. THERMAL CAPSULORRHAPHY FOR THE TREATMENT OF MULTI-DIRECTIONAL INSTABILITY OF THE SHOULDER.

***Anthony Miniaci, MD, FRCSC;** Sara Lyn Miniaci; Julie McBirnia*

Purpose: The objective of this study was to perform a prospective evaluation of thermal capsulorrhaphy for the treatment of multi-directional instability of the shoulder.

Summary of Method: Thermal capsulorrhaphy has become commonly used in the treatment of various instability disorders of the shoulder. Theoretically, reduction or shrinkage of shoulder capsule or glenohumeral ligaments should be able to resolve instability problems, which are related to capsular redundancy as opposed to labral detachments or tears. Therefore multi-directional laxity of the shoulder should theoretically have the best possibility of surgical success with thermal capsulorrhaphy. The purpose of this study was to present the prospective evaluation of 19 patients with instability of the shoulder related to multi-directional laxity treated with thermal capsulorrhaphy (Oratec). Over a period of two years, 19 patients with multi-directional instability were treated with thermal shrinkage. Fifteen patients had involuntary dislocation and four voluntary. The predominant direction of instability was anterior/ inferior in 10, posterior in 5 and multiple directions in 4. Patients were followed for a minimum of two years or until surgical failure recurrence of symptomatology. Patients were treated with thermal capsulorrhaphy, and maintained in sling immobilization for a period of 3 weeks post-operatively. At that time patients were reviewed regularly at 6 weeks, and 3, 6, 9 and 12 months and then at six month intervals. The Western Ontario Shoulder Instability Index was used as a clinical outcome measure as well as subjective and objective evaluation of patient's function, range of motion, pain and instability.

Results: Nine patients had recurrence of their instability occurring at an average of nine months following their surgical procedure (range 7-14 months). One patient had axillary nerve dysfunction post-operatively with difficulty in abducting the shoulder. Three patients had additional sensory dysesthesias related to the axillary nerve territory. All neurological subjective evaluations recovered within 9 months. All the patients with predominantly posterior direction to their instability failed this surgical procedure. Only 2 of 10 (20%) with anterior instability as their predominant complaint had failed their operative procedure. Surgical revision has been performed in 5 of the 9 failures.

Discussion: Thermal capsulorrhaphy has been advocated for the treatment of shoulder instability problems especially those related to capsular laxity. Analysis of patients with multidirectional laxity determined that thermal capsulorrhaphy had a significant failure rate with associated post-operative complications. Specifically those patients with a predominantly posterior component of instability as their main complaint had no surgical success with this type of surgical procedure. We have abandoned this type of approach in patients with multi-directional laxity especially in those with posterior instability.

Conclusion: This new operative procedure met with a high failure rate, (9/19, 47%) with significant post-operative complications including axillary nerve dysesthesias and stiffness.

161. ARTHROSCOPIC PARTIAL MENISCECTOMY IN OLDER THAN FIFTY YEARS.

***Vicente Gutierrez**; Fernando Radice*

The purpose of this study was to evaluate the results of arthroscopic partial meniscectomy in patients of more than 50 years. A retrospective analysis of 43 knees from 39 patients older than 50 years, who had undergone an arthroscopic partial meniscectomy was carried out. The mean age of the patients was 60 years (range, 50 to 74), and the mean follow-up period was 38 months (range, 5 to 62). The patients were divided into two groups based on the degree of articular degeneration.

Group I consisted of 18 knees that did not have any significant articular damage beyond grade I or II. Group II consisted of 25 knees that had grade III or IV cartilage damage. Overall, excellent results were obtained in 24 knees, good results in 14 knees, fair results in 5 knees. In Group I 17 knees (94%) had an excellent and good outcome and only one had a fair result. In contrast 21 knees (84%) of Group II had excellent and good results, and four knees had a fair result. The results were better when arthroscopic meniscectomy was performed earlier, in younger patients and when the degree of articular degeneration was low. Arthroscopic partial meniscectomy in patients older than 50 years is an acceptable and effective treatment option, and it gives a significant relief of symptoms and a functional improvement.

162. ATYPICAL HIGH-RIDING WRISBERG'S LIGAMENT IN DISCOID LATERAL MENISCI. ***Chul W. Ha, MD****; Jin Hwan Ahn, MD; Kwon-Ick Ha, MD*

INTRODUCTION: The authors found an atypical characteristics of the Wrisberg's ligament (posterior meniscofemoral ligament) in some cases of discoid lateral menisci, and its clinical significance in the aspect of the tear pattern of the menisci. On MRI, the atypical high-riding Wrisberg's ligament attaches to the medial femoral condyle much higher than the typical one.

OBJECTIVE: This study is to identify the incidence of the Wrisberg's ligament and its atypism in knees with discoid lateral menisci, and to analyze the relation between the atypical high-riding Wrisberg's ligament and the tear patterns of discoid lateral menisci.

METHODS: The MRI of 50 knees with symptomatic discoid lateral menisci and 50 normal knees with no meniscal abnormalities were reviewed. The arthroscopic findings of tear patterns of the discoid menisci were analyzed in relation to the presence or absence of the atypical Wrisberg's ligament.

RESULTS: The Wrisberg's ligament was more commonly present in the discoid group (84%) than in the normal group (54%) ($p<0.01$). Atypical high-riding Wrisberg's ligament was much more common in the discoid group (44%) than in the normal group (4%) ($p<0.01$). When the atypical Wrisberg's ligament was present, peripheral longitudinal tear is the predominant tear pattern (76%). When it was absent, horizontal tear was the predominant tear pattern (75%).

DISCUSSION & CONCLUSION: The incidence of the Wrisberg's ligament and its atypism in discoid lateral menisci was much higher than in the normal group. The atypical Wrisberg's ligament is considered to be an important factor causing peripheral longitudinal tear of discoid lateral menisci.

The atypical high-riding Wrisberg's ligament was considered to be one of the possible causes of the development of the discoid lateral menisci. The authors have a suspicion of misinterpretation on the "Wrisberg's-ligament type" of discoid lateral menisci from the findings in this study.

164. BIONX MENISCAL ARROW™: RESULTS AND COMPLICATIONS (A STUDY OF 686 CASES OF MENISCAL REPAIR). *Christian Bentley, MD; Robert Pedowitz, MD, PhD; Steven Tradonsky, MD; Dilworth W. Cannon, MD;* ***James P. Tasto, MD*** *(a, b – Bionx)*

Introduction: The Bionx Meniscal Arrow™ (Bionx Implants Inc.; Blue Bell, PA) is an alternative to more invasive and time-consuming meniscal repair techniques. Since its introduction in 1996, these recognized benefits have resulted in its use in over 100,000 cases of meniscal repair. Only a limited number of clinical outcome studies are available in the literature regarding the clinical success of the Meniscal Arrow™ and a small number of case reports regarding complications. This study represents the largest clinical series reporting results and complications associated with the Bionx Meniscal Arrow™.

Materials/Methods: A retrospective analysis was performed on 686 cases of meniscal repair utilizing the Bionx Meniscal Arrow™ performed by 28 prominent arthroscopists and sports medicine fellowship-trained orthopedic surgeons. Patient demographics, tear patterns, associated surgical procedures, clinical outcome, and complications were analyzed. Inclusion criteria included a mandatory minimum two-year follow-up and any participating physician's use of the Meniscal Arrow. The criteria for a healed meniscus tear were absence of pain at the joint line, no locking, and no effusion.

Results: The majority of patients undergoing meniscal repair were between the ages of 20 to 39 (54.8%). The most common type of tear repaired was a vertical longitudinal tear (73.2%) of the posterior horn (50%). White-white zone repairs comprised 12.3% of repairs. Repairs of meniscal tears less than 10 mm (1 cm) in length were performed 21% of the time. A hybrid technique of meniscal repair was performed using sutures in addition to the Arrow in 10.5% of repairs. Clinical healing occurred in 526/558 (93.4%) attempted repairs. Re-tear of the repaired meniscus was noted in 8/686 (1%) cases. Complications directly attributable to the arrow (i.e., loose or extruded arrow, pain over the tip, saphenous nerve entrapment, etc.) total 13/686 (1%).

Discussion: Although some biomechanical studies have suggested that the meniscal arrow may demonstrate diminished pull-out strength relative to vertical sutures, this may not be an in vivo problem. Recent case reports of Arrow-related complications do not appear to be a significant problem in a large population of meniscal repairs. There is evidence in this study that the arrow is not always used as recommended by the manufacturer.

Conclusion: Meniscal repair with the Bionx Meniscal Arrow™ is a safe and effective technique with low morbidity and excellent clinical results if used with the appropriate indications and surgical technique.

165. THE USE OF THE MENISCUS ARROW® FOR A NEW INDICATION: MECHANICAL TESTS. ***Diederick B. Wouters, MD****; Leonora J. de Mouton, MD, PhD*

Introduction: Many different devices have been used and are still used for fixation of osteochondral fragments. Of the biodegradable devices, mostly pins are used, with the disadvantage, that they cannot accomplish sufficient compression.

Method: To test the mechanical properties of the biodegradable Meniscus Arrows for this purpose, 3 times Single arrows were inserted in human condyles and pulled out, using a draw – bench (type Instron 1195). The extraction speed was 5 mm / min. Two times, the arrow was reinserted after extraction and was, again, pulled out. Also pulled out tests and shear force tests were performed with a bone block with 3 arrows. The values were compared with pull out force tests with a 2 mm ∅ A.O. screw.

Results: The force, needed to pull out the single Meniscus Arrow, varied between 59N and 78N, with a mean value of 68. After reinsertion 55N and 44N. For the bone block, the pull out force was between 108N and 148N, with an average of 122N. The shear force values were between 115N and 128N with an average of 121. The values of the screw pull out tests were between 162N and 334N, average 236N.

Conclusion: The Meniscus Arrow shows remarkable pull out force values, if inserted in bone and higher than in meniscus tissue. They seem sufficient for temporary fixation of osteochondral fragments if the post-operative regime is adapted to this. The 2 mm ∅ A.O. screw shows much higher pull out force values, but the question is, whether this is really required.

166. A PROSPECTIVE RANDOMIZED CLINICAL TRIAL COMPARING BIODEGRADABLE ARROWS TO INSIDE-OUT SUTURING FOR MENISCAL REPAIR. ***Alexandra Kirkley, MD,*** *FRCSC (a – Bionx); Dianne Jackowski, BA; Robert Litchfield, MD, FRCSC; Annunziato Amendola, MD, FRCSC; James Dill, MD; Peter Fowler, MD, FRCSC*

Introduction: The inside-out suturing technique is the most preferred method of meniscal repair although several all-inside techniques have recently been introduced.

Objective: The purpose of this study is to compare the effectiveness of inside-out suturing to bioabsorbable Arrows for meniscal repair in a prospective randomized clinical trial.

Method: 67 consecutive patients found to have a reparable meniscal lesion who met specific inclusion/exclusion criteria were randomly assigned to Arrows (10 and 13 mm) or sutures (#2 Ethibond vertically oriented, inside-out). Randomization was stratified by surgeon and concomitant ACL reconstruction. A research associate, blinded to group assignment (by having patients wear a tubigrip over their knee during evaluations), conducted all follow-up assessments at 6 weeks and 3, 6, 12, 24, 36 months. The Western Ontario Meniscal Evaluation Tool (WOMET), Mohtadi (ACL Score), IKDC and range of motion were used to assess outcome.

Results: At baseline, both groups were similar with respect to age, gender, time from injury to surgery, length of tear and proportion undergoing concomitant ACL reconstruction. The average follow-up is 14.1 months (6 to 24 months). Two patients randomized to the Arrow group were crossed-over to the suture group at the time of surgery due to technical difficulty with insertion of the device. In 3 instances, a single suture was needed to keep the tear reduced while Arrows were introduced. To this time, there have been 5 patients with failed meniscal repair requiring re-operation in the Arrow group and 3 failed repairs in the suture group which is not statistically different. In addition, 2 patients required removal of a prominent Arrow and 1 patient in the suture group suffered a transient peroneal nerve palsy.

Conclusion: At intermediate follow-up there is no statistically significant difference in re-tear between meniscal suturing and meniscal Arrows but complete long-term follow-up is necessary to accurately estimate the difference between these two treatments.

169. VOLUMETRIC CHANGE IN THE SHOULDER CAPSULE AFTER OPEN INFERIOR CAPSULAR SHIFT VERSUS ARTHROSCOPIC THERMAL CAPSULAR SHRINKAGE: A CADAVERIC MODEL. *Aron D. Rovner, MD; Timothy A. Luke, MD; Spero G. Karas, MD;* ***Kevin D. Plancher, MD, FACS, FAAOS****; Richard J. Hawkins, MD*

Objective: Thermal capsular shrinkage and standard open inferior capsular shift are two procedures used for multi-directional instability of the shoulder. The purpose of this study is to evaluate and compare the change in volume of the shoulder capsule before and after these two surgical procedures.

Methods: Six matched fresh-frozen cadaveric shoulders were stripped and the rotator cuff muscles exposed. Standard open inferior capsular shift was performed on six right shoulders and thermal (Oratec) capsular shrinkage was performed on six left shoulders. The shoulder capsule volume was measured three times before and after the surgical procedure.

Results: Open capsular shift on average decreased the shoulder capsule volume 50% (range 43-56) and the thermal shrinkage on average decreased the shoulder capsule volume 30% (26-36). This change was statistically significant ($P<0.05$). This cadaveric model showed that open capsular shift decreased the volume 1.7 times as much as thermal capsular shrinkage for the multi-directional instability procedure.

Conclusions: Standard open inferior capsular shift and thermal capsular shrinkage are procedures for treating multi-directional instability. This cadaveric study found that both procedures are effective in decreasing the volume of the shoulder capsule. The open inferior capsular shift decreased the shoulder capsule volume 1.7 times more than thermal shrinkage. Further studies using in vivo model to study volume change pre and post these procedures should be considered to further compare these two procedures.

170. ARTHROSCOPIC BANKART REPAIR WITH SUTURE ANCHORS. THE GOLD STANDARD WITH AN ACCURATE PATIENT SELECTION. ***Guillermo Arce, MD****; Pablo Lacroze, MD; Juan Previgliano, MD; Daniel Alonso, MD*

Objective: To evaluate the results of arthroscopic Bankart repair using suture anchors in the treatment of anterior glenohumeral instability in a select group of patients.

Methods: Thirty-nine shoulders (37 patients) with post-traumatic anterior glenohumeral instability were prospective select for arthroscopic stabilization. We followed strict criteria for patient selection; only patients with post-traumatic anterior instability, less than five dislocations, negative sulcus sign, mild or negative Hill-Sachs lesion and a Bankart lesion in the MRI were included. Age average at surgery was 28.3 years (17-54). Thirteen patients (35.1%) were involved in contact sports, nineteen (51.3%) in throwing sports and five (13.5%) were not involved in sports. Thirty shoulders (76.9%) were dominant; nine (23.0%) were non-dominant. All patients were operated on by two of us (G.A. and P.L.) using the same surgical technique (beach chair position, 2 to 4 suture anchors, with #2 nonabsorbable suture for stabilization). All patients were immobilized 4 weeks postoperative. Return to previous sport was allowed at 6 months. Patients were evaluated with a mean follow-up of 39.2 months (24-64) using the UCLA End-Result Score.

Results: Twenty-nine (74.3%) cases were classified as excellent results (34-35 points), 9 (23.0%) as good (29-33 points) and 1 (2.5%) as poor when assessed with UCLA score. No recurrences, neither signs of instability have occurred. Average postoperative ROM was 160° forward flexion, 90° external rotation in abduction, and T 7 of internal rotation.

Conclusions and Significance: With an accurate patient selection arthroscopic shoulder stabilization seems to be the gold standard for this group of patients.

171. FOLLOW-UP RESULTS OF FOUR STABILIZATION PROCEDURES FOR RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER. ***Valdis Zatlers****; Juris Matisons; Janis Vilums; Mareks Matchuks*

Summary: The aim of this study was to evaluate and compare ROM, incidence of recurrence and possibility to return to sports activities at the same preinjury level of four different stabilisation procedures.

Materials and methods: Clinical evaluation of 12 modified Bristow (group A);14 Boychev (group B); 13 alloplastic extracapsular limboplastic (group C) and 9 arthroscopic Bankart repair using absorbable Suretac tacks (group D) procedures performed between 1987 and 1998 was done by the same independent examiner. All 48 patients had traumatic recurrent anterior dislocation of the shoulder, mean age 30 (16 - 55) , the average number of dislocations 7.2 and average follow-up period 34.8 months.

Results: There were some limitations of ROM in all groups. Average postsurgery loss of motion was 19 degrees of external rotation compared with noneffective shoulder. Maximum 31 degree in group A. The number of recurrence was 3 in groups B and C, one in group D and none in group A. Five patients from 6 in group A, 6 patients from 7 in group D, 2 patients from 3 in group C and no patients from 4 in group B have returned to sports activities at the same level.

Conclusions: The modified Bristow procedure had more severe limitation of external rotation, but clinical results and activity level after surgery were excellent. Arthroscopic Bankart repair using absorbable Suretac tacks showed the best ROM and low recurrence rate for patients with small number of dislocations. Boytchev and alloplastic extracapsular limboplastic procedures had good ROM, but fair stability. These two methods should not be recommended for young active patients.

172. CORACOID IMPINGEMENT SYNDROME: A PROSPECTIVE, CONTROLLED STUDY. *Carl J. Basamania, MD; John F. Kragh Jr., MD; John Lee, MD; Nancy M. Major, MD*

Objective: We present a prospective, controlled study of primary coracoid impingement syndrome with secondary cases as a control.

Methods: We diagnosed primary coracoid impingement in twelve athletes who required coracoplasty (thirteen shoulders). "Burning" pain occurred at a tender coracoid with push-ups. Conservative treatment failed. Hawkins' and Neer's signs were often positive. Coracoid tip injections confirmed the diagnosis. At surgery, a narrow coracohumeral interval was narrow in each case. Follow-up averaged 2.2 years (1-5 range). Ages averaged 31 years (20-41). We used a secondary coracoid impingement group for controls. Seven patients had secondary impingement. We used Student's t-test (right-tailed) for group means. We analyzed categorical data with Wilcoxon's rank-sum test.

Results: MRI suggested a narrow coracohumeral interval at 10 mm (6-13 range). Thirteen shoulders required coracoplasty. Arthroscopy and bursascopy were helpful in assessing comorbidity. Improvements in visual analog pain scales (VAS) (5.6 average improvement, 3-9, $p=0.03$), function (Single Assessment Numerical Evaluation, SANE) (52 percentage points average improvement, 22-82, $p=0.007$), and patient satisfaction (12 excellent, 1 satisfactory, $p=0.02$) showed good results. For the control group, improvements in pain (2.9 average improvement, 1-6, $p=0.08$), function (22, 0-40, $p=0.04$), and satisfaction (5 satisfactory, 2 unsatisfactory, $p=0.02$) showed mixed results.

Conclusions and Significance: Under-diagnosis of coracoid impingement may be why some patients do not respond fully after arthroscopic subacromial decompression. With characteristic histories, exams, imaging and selective injections, the diagnosis can be made and confirmed at surgery. The literature had only eight small case series of similar syndromes. Coracoplasty can alleviate pain in selected patients.

173. SUBACROMIAL DECOMPRESSION OF THE SHOULDER BY ARTHROSCOPY. EVALUATION AND RESULTS. *Niso Eduardo Balsini, MD*

Purpose: To demonstrate the authors' experience in shoulder subacromial decompression surgery by arthroscopy and their results.

Methods: From March 1996 to May 1999, 61 surgeries were done by arthroscopy in the shoulder, 46 of them for subacromial decompression for impingement's syndrome treatment. All the surgeries were done by the same surgeon, always in phase II of Neer. The maximum follow-up was three years and the minimum six months. The patients' minimum age was 25 years and the maximum 59, with an average of 44 years old, 25 males and 21 females. The dominant shoulder was affected in 63% of the cases. Associated lesions were diagnosed in 34.7% of the arthroscopies.

Results: The evaluation was concluded according to the protocol of the UCLA (University of California at Los Angeles), with excellent results in 47.8% of the cases (UCLA 34 - 35), good in 45.6 (UCLA 28 -33), reasonable in 4.3% (UCLA 21 - 27), bad in 2.17% (UCLA 0 - 20). The final results were 96.9% included as good and excellent.

According to the literature, other authors had similar results, as Esch (82%), Van Holsbech (83%), Paulos (85%), Ellman (88%), Gartsman (90%), Godinho (90.8%) and Altcheck (92%).

Conclusion: The authors comment about the importance of the deltoid muscle preservation and also about the opportunity of evaluation and solution of glenohumeral associated lesions, by arthroscopy, main difference of the open surgery.

Significance: The technique of subacromial decompression by arthroscopy can be elected as an excellent technique, with good results and improvement possibilities.

174. DNA FINGERPRINTING AND FRESH MENISCAL ALLOGRAFTS. *Tom Lootens, MD; Karl Frederik Almqvist, MD; Peter Verdonk, MD; René Verdonk, MD, PhD*

PURPOSE: The integration of acceptor fibrochondrocytes into human viable meniscal allografts was evaluated in this study.

METHOD: 16 of 80 patients who had received a viable allogenic meniscal transplant underwent a follow-up arthroscopy during which a biopsy specimen was obtained from the implanted menisci. DNA fingerprinting was performed to evaluate possible ingrowth of the meniscal allograft by acceptor fibrochondrocytes.

RESULTS: The follow-up arthroscopy was performed at a mean of 2 years and 3 months after transplantation. The compared DNA region showed complete matching in 6 cases, incomplete matching (cell population of the recipient and the donor) in 1 case, and non-matching in 3 cases. The remaining 6 cases could not be analyzed due to culture failure.

CONCLUSION: These findings suggest partial or complete ingrowth of the transplanted meniscus by acceptor fibrochondrocytes in the majority of cases. However, non-matching does not imply graft failure as evidenced by a simultaneous clinical examination using the Hospital for Special Surgery knee-rating score, and by the macroscopic aspect during follow-up arthroscopy.

175. ARTHROSCOPIC EVALUATION OF ALLOGENIC MENISCAL REPLACEMENT. *Kwang-Won Lee, MD; Tae-Goo Ahn, MD; Jun-Sik Kim, MD; Won-Sik Choy, MD*

PURPOSE: Meniscectomy can result in degenerative disease, with younger patients developing problems in middle age. In addition, loss of a major portion of a medial meniscus may increase instability in anterior cruciate deficient knee. For these reasons, it is theoretically desirable to transplant menisci in selected patients. The purpose of this study is to evaluate arthroscopically the morphological changes of the transplanted human allogenic meniscus.

METHOD: From Feb. 1-996 to Dec. 1997, among twenty-four patients of allogenic meniscal transplantation, fourteen patients (9 cryo-preserved, 5 fresh-frozen) of volunteer, 10 men, 4 women, from 18 to 43 (27.6 years) year old underwent arthroscopic evaluation (7 medial and 7 lateral) at the time of follow-up (from 6 to 48 months, average 24 months). At the time of transplantation, 7 patients had additional procedures, including six who underwent ACL reconstruction, one who had osteochondral graft for defects of the medial femoral condyle. All of the procedures were performed arthroscopically. For the fixation of the meniscus we used bone-plug method for nine,

key-hole method for three, and bone-bridge method for one patient. MRIs of the five knees were taken at 6 months and 1 year after the operation. In three patients, biopsy samples were taken from the peripheral and central portion of the grafted meniscus.

RESULTS: The second-look arthroscopy revealed that grafts were viable and well incorporated with surrounding capsular tissue. In all cases, the substance of the meniscus was probed and felt to be normal. There was no evidence of shrinkage except one case.

CONCLUSION AND SIGNIFICANCE: We could find that second-look arthroscopy revealed that well incorporated of the allograft with firm attachment throughout its entirety. Although early clinical results seem promising, further biomechanical and biochemical studies are necessary to truly assess whether meniscal transplants will prevent degenerative changes, and enhance stability

176. MENISCAL ALLOGRAFT TRANSPLANTATION: 2 TO 8 YEAR MID-TERM RESULTS. ***Ehud Rath, MD****; John C. Richmond, MD; W. Yassir, MD; J.D. Albright, MD*

Objective: To identify the intermediate-term functional and radiographic outcomes of meniscal allografts, and identify potential causes for failure.

Methods: 18 consecutive patients that underwent meniscal allograft transplantation (22 menisci) for compartmental pain were reviewed 2-8 years following implantation. Cryopreserved menisci were implanted using bone blocks. Follow-up included chart review, physical examination, IKDC 1999 Knee Function Evaluation preoperative and postoperative SF-36, weight-bearing flexed knee radiographs, and histologic analysis of all subsequently removed meniscal tissue, including quantitative cell counts, and selective cytokine assessment of selected specimens. Control menisci for the histologic and cytokine analysis included normal and torn menisci.

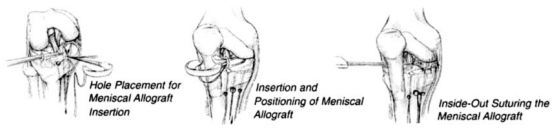
Results: 10 patients have been arthroscoped since the index procedure, all have shown complete healing of the meniscus to the bed. 8 of the 22 implanted menisci (36.36%) have symptomatically torn and required subsequent meniscectomy (2 total and 6 partial). These 2 total resections have been re-implanted. None of the remaining patients has signs or symptoms of meniscal tearing. The SF-36 pain score improved significantly ($p<0.0001$) from pre-op to final follow-up. The majority of patients continue to show significant functional limitations (IKDC 1999 Functional Score: mean=54.3, range 35-82). Quantitative histologic analysis revealed a greater than 50% reduction in the number of meniscal fibrochondrocytes in the torn allograft menisci, when compared to normal menisci or torn native menisci ($p<0.05$). All menisci demonstrated positive staining for PDGF and TGF-b.

Conclusions: While meniscal transplantation can effectively reduce the pain that often is a late consequence of major meniscectomy, this and a number of other studies have revealed significant rates of tearing of the implants. This study suggests that these high failure rates may be caused by inadequate re-population of the implant by host cells and subsequent failure of the tissue.

177. SURGICAL TECHNIQUE OF MENISCAL REPLACEMENT IN ARTHRITIC KNEES ***Kevin R. Stone, MD*** *(a, b, d, e – Crosscart, Inc.; c – DePuy-Orthotec); Ann Walgenbach, RN, NP, MSN,*

OBJECTIVES: Meniscal cartilage replacement by allograft, prosthesis, and regeneration scaffolds has advanced from the laboratory to clinical practice. Since the first reported human meniscal allograft was performed by Michalowski in 1986, approximately 4,000 meniscal replacements have been performed in the United States. Most have be performed in knees without arthritis. We hypothesized that meniscal replacement could augment standard chondroplasties in arthritic knees. In order to overcome difficulties with arthritic knee deformities and the paucity of surgical instrumentation, the authors developed a technique to aid placement and fixation of the meniscal allografts. This study is the first of a series. This first study evaluates the technical difficulties and survivability of the implant in the arthritic knee. A second study will compare chondroplasty alone to chondroplasty plus meniscal allografting in the primarily unicompartmental arthritic knee.

METHODS: All patients signed informed consents, underwent preoperative exams, X-rays, MRIs and completed pre- and post-operative Tegner, ADLS and WOMAC questions at sequential follow-up intervals. The arthroscopic surgical implant procedure implements a three-tunnel technique to secure the anterior and posterior meniscal horns and posterior corner of the allograft. Additional stabilization of the implant is achieved through an inside-out suture technique, shown in the following figures:



RESULTS: At an average follow-up of 1.2 years (range 0.5 to 2.7 years) preliminary results from a 47 patient prospective study of patients with Grade IV arthritis show reduction in pain scores pre to post-surgery of 6.2 to 4.6 (scale 1-10; 1 being no pain) ($p\leq0.2$), and increases in activity levels from 1.3 to 1.7 (scale 1-3) ($p\leq0.05$). WOMAC, Tegner, and ADLS scores also showed improvement. The re-tear rate was 6 of 47 implants.

CONCLUSIONS: Meniscal allografting can be successfully performed in arthritic knees, although with a 13% re-tear rate. The specific cause of the pain relief cannot be pinpointed due to the multiple concomitant procedures performed in these complex knees as well as the patient's participation in a defined rehabilitation program. It is the authors' impression, however, that meniscal transplantation in arthritic knees augments standard care, and leads to favorable outcomes in this evaluation period. A controlled, comparative study will be required to prove this clinical impression. Further segmentation of these results over time will help clarify the role of meniscal allografting in arthritic knees.

178. IMPROVEMENT OF MENISCUS, BUT NOT OF OSTEOARTHROSIS-RELATED SCINTIGRAPHIC PATTERNS FOLLOWING ACL RECONSTRUCTION: PROSPECTIVE STUDY. ***T. Hogervorst, MD****; T.H. Pels Rycken, MD; C.P. van der Hart, MD; W.K. Taconis, MD, PhD*

Objective: Approximately 75% of symptomatic ACL-deficient patients have an abnormal bone scan of the unstable knee. We hypothesise that normalisation of scintigraphic uptake following ACL-reconstruction indicates reversal of pathologic loading of the knee, protecting from further degenerative changes. We studied the effect of ACL-reconstruction on abnormal scintigraphic patterns.

Methods: Bone scans were made in 95 patients prior to arthroscopic ACL-reconstruction and repeated two years postoperatively in 80 of these 95 patients. The fifteen patients without repeat scan were not different from the remaining 80 regarding duration of ACL-deficiency, preoperative scan patterns, or meniscus and cartilage abnormalities. Changes in scintigraphic patterns were correlated to duration of ACL-deficiency, meniscus and cartilage abnormalities, subjective outcome, KT-1000 measurements, and radiographic changes.

Results: Local uptake at the posterior tibial rim ("meniscus pattern"), seen in 46 knees pre-operatively, normalised in 41 (89%) of

these 46 knees. Local uptake deep to the subchondral surface of the tibiofemoral compartment ("cartilage ulcus"), improved after ACL-reconstruction only when local chondropathy was less than grade 3. Diffuse uptake in the subchondral joint contour ("osteoarthrosis pattern") did not change: It was seen in 63 knees preoperatively (79%) and in 67 knees at two 2 years (84%). Radiographic deterioration was not seen in this two year follow-up period.

Conclusion: These findings indicate a load reduction on the posterior horn of the menisci after ACL-reconstruction. However, two years postoperatively, osseous homeostasis is not restored in the majority of patients. Long-term follow-up of this group will learn whether patients with abnormal scans develop osteoarthrosis.

179. THE EFFECT OF ESTROGEN ON MATERIAL AND MECHANICAL PROPERTIES OF THE INTRA & EXTRA ARTICULAR KNEE STRUCTURES.

***Elizabeth A. Arendt, MD**; Kenji Sudoh, BS; Fred A. Wentorf, MS*

Introduction: Female athletes have a higher incidence of noncontact knee injuries compared to male athletes in similar sports; with anterior cruciate ligament (ACL) tears being the most common. Different arguments for this gender discrepancy have been postulated, including: anatomical, neuromuscular, hormonal, and more. Of these arguments, the contribution of hormonal differences to decreasing the ligament strength is unclear. The purpose of this study is to evaluate the effect of estrogen on material and mechanical properties of the intra and extra-articular knee structures.

Materials & Methods: 26 young female rhesus monkeys were divided into two surgical groups, sham (n = 12) and ovariectomized (n = 14). Both groups were kept in similar facilities with similar food and exercise levels. Two years after the surgery, animals in both groups were euthanized and the knees harvested. The ACL and central third of the patellar tendon (PT) were pulled to failure at 100% / second on a hydraulic MTS testing machine (MTS corporation, Edina, MN, USA). During testing, the load and displacement were recorded. Statistical analysis was performed using a Student's T-test, with a p-value < 0.05 being considered significant.

Results: There was found to be no significant difference in any material or mechanical parameter between the control and ovariectomized groups for either ACL or PT (Table 1).

Conclusions: This study shows that estrogen has no effect on the material or mechanical properties of both intra and extra-articular knee structures. Thus, effort should be made to evaluate the effect of other parameters that could be effecting female athlete's knee injury rate.

TABLE 1. MATERIAL AND MECHANICAL PROPERTIES OF THE ACL AND PT

Maximum Force (N)	Stiffness (N/mm)	Maximum Stress (MPa)	
ACL – Sham	394±67	171±26	115±28
ACL – OVX	392±96	180±28	128±30
PT – Sham	372±80	187±29	102±21
PT – OVX	368±86	184±26	104±29

180. A GENDER COMPARISON OF HAMSTRING TENDON GRAFT DIAMETER DURING ACL RECONSTRUCTION.

***Alexandra Kirkley, MD** (a – Bionx); Dianne Jackowski, BA; Robert Litchfield, MD; Annunziato Amendola, MD; Seune Gauthier; Peter Fowler, MD*

Introduction: Recent studies evaluating the risk of anterior cruciate ligament (ACL) injury and outcome following ACL reconstruction have suggested that there are significant differences between genders. ACL reconstruction using hamstring tendons is often chosen for women as opposed to patellar tendon autograft, as women more frequently suffer from pain syndromes of the extensor mechanism. However, concerns over the adequacy of size of hamstring tendons in women has been recently expressed. The purpose of this investigation was to determine whether there is a difference in the size of hamstring tendon grafts between genders when controlling for height and weight.

Method: Male and female patients undergoing anterior cruciate ligament reconstruction (using a four-strand, semi-tendinosis and gracilis hamstring autograft) were recruited for this study. The height (cm) and weight (kg) of each patient as well as the diameter of their graft as measured by the smallest cylinder diameter (mm) that the graft could be pulled through, were recorded and entered into a database.

Results: 121 subjects were consecutively entered into the study, 73 (60.3%) males and 48 (39.7%) females. The average height for males was 175.10 ± 6.42 cm and 162.54 ± 6.89 cm for females. Weight was not used in the analysis for two reasons. First, since height and weight are highly correlated ($r=0.668$, $p<0.01$), the amount of variance accounted for by weight, that is not already accounted for by height, is minute. Second, it is more biologically plausible that a person's height will predict hamstring size and thus graft diameter. The average graft diameter was 7.59 ± 0.67 mm for males and 6.99 ± 0.53 mm for females. The difference between sexes for graft size, controlling for height, was statistically significant ($p=0.021$) and the slope of the regression equation that predicts graft size given height also demonstrates a difference between genders. This indicates that the size of the hamstring tendons is smaller for females than for males of the same height. For example, given a height of 165.0 cm, the graft size for a male is predicted to be 7.52 ± 1.16 mm whereas the graft size for a female is predicted to be 7.04 ± 0.92 mm.

Conclusion: There is a significant difference between the size of male and female quadruple hamstring tendon autografts. It remains to be determined whether the smaller size hamstring autograft is adequate for long term stabilisation of the female athlete's knee.

181. PATELLAR TENDON OR SEMITENDINOSUS AUTOGRAFTS FOR ACL RECONSTRUCTION? A PROSPECTIVE RANDOMISED STUDY.

***Lars Ejerhed**; Jüri Kartus; Kristina Köhler; Ninni Sernert; Jon Karlsson*

Purpose: To compare the results after arthroscopic anterior cruciate ligament (ACL) reconstruction using central third patellar tendon autografts with the use of triple/quadruple semitendinosus autografts.

Methods: A randomised series of 72 patients with unilateral ACL rupture were included in the study. The patellar tendon was used in 36 patients (Group PT) and the semitendinosus was used in 35 patients (Group ST). In both groups interference screw fixation was used on the femoral and tibial sides. The pre-operative assessments were similar in terms of gender, age and activity level. Median (range) values are reported and non-parametric tests were used.

Results: In Group PT 35/37 patients and in Group ST 34/35 patients returned to follow-up after 25 (23-30) and 24 (20-29) months respectively (n.s.). One patient in each group had sustained a rupture of the graft during the follow-up period. The Lysholm score was 95 (58-100) points in Group PT and 90 (37-100) points in Group ST (n.s.; $p=0.25$.). The Tegner activity level was 6 (1-9) in Group PT and 6.5 (3-9) in Group ST (n.s.). The KT-1000 anterior side-to-side difference was 2.0 (-5-11.5) mm in Group PT and 2.5 (4-10.5) mm in Group ST (n. s.; $p=0.14$). The one-leg-hop test was 93 (0-123)% in Group PT and 92 (0-122)% in Group ST (n.s.). In terms of the final IKDC classification no significant differences were found. In Group PT 51% and in Group

ST 26% of the patients classified the knee walking test as difficult or impossible to perform ($p=0.0005$).

Conclusions: At the two-year follow-up the use of semitendinosus autografts at ACL reconstruction rendered significantly less discomfort during the knee walking test than the use of patellar tendon autografts. With regards to all other parameters the results were similar.

182. THE IMPACT OF FIXATION LEVEL AND FIXATION METHOD ON ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTIONS. ***Sven Scheffler****; Norbert P. Südkamp; Andreas Gockenjan; Andreas Weiler (a – Linvatec Corp.)*

ACL reconstruction techniques show substantial differences in regards to fixation level, fixation method and graft configuration. The objective of this study was to biomechanically evaluate five clinically relevant reconstruction techniques with the hypothesis that tendon graft fixation close to the joint line and directly without linkage materials would improve their respective mechanical properties.

40 human cadaveric knees (avg. 39 years) were reconstructed with four hamstring and one patellar tendon technique in groups of eight. In two of the hamstring (TST_{Bio}, $DGST_{RCI}$) and in the patellar tendon (PAT) group, more anatomic reconstruction was achieved with direct interference fit fixation while in the remaining two hamstring groups graft fixation was accomplished away from the joint line on the tibial and femoral cortex either through linkage materials on both sides ($DGST_{Button}$) or in combination with direct soft-tissue washer fixation ($DGST_{Washer}$). The reconstructed knee joints were cyclically loaded with an incremental load increase of 20N until failure.

The more anatomical reconstructions provided significantly higher stiffness, more accurate restoration of the loading-unloading behavior of the intact ACL (energy loss) and decreased anterior displacement.

The tibial fixation site was the weak link in all anatomical reconstructions. Bone-block use with direct interference fit fixation especially in the tibial tunnel improved the mechanical properties significantly. Usage of linkage materials for graft fixation ($DGST_{Button}$, $DGST_{Washer}$) resulted in significantly larger anterior displacements and laxity increase.

Bone-block use with direct interference fit fixation improved the mechanical stability of ACL reconstructions directly after surgery, allowing for early aggressive rehabilitation.

MAXIMUM TENSILE PROPERTIES FOR EACH RECONSTRUCTION TECHNIQUE

	Max	TST_{Bio}	$DGST_{RCI}$	$DGST_{Button}$	$DGST_{Washer}$	PAT	ACL intact
Load (N)	375	(144)	b,d	207 (50)	a,c,d,e	505 (43) b,e	554 (91) a,b,e
Stiffness (N/mm)	52 (15)b	35 (10) a,e	42 (10) e	43 (10) e	66 (22) b,c,d	189 (21) f	384 (170) b,c,d
Displacement (mm)	24 (9) c	19 (9) c,d	41 (11) a,b,e	34 (8) b,e	19 (13) c,d	19 (4) c,d	1994 (206) f
Energy Loss (mJ)	at 300N480 (193)c,d,e	all failed	950 (184)a,e	832 (177)a,e	197 (99)a,c,d	27 (10)f	

a-f represent significantly different corresponding data pairs
a: sig. different from TST_{Bio} **b:** sig. different from $DGST_{RCI}$ **c:** significantly different from $DGST_{Button}$ **d:** sig. different from $DGST_{Washer}$ **e:** sig. different from PAT **f:** sig. higher than all reconstruction techs

183. LONG-TERM RESULTS OF ACL GRAFT WITH MENISCECTOMY REALISED BEFORE OR DURING OPERATION – 64 CASES WITH 17 YEARS' FOLLOW-UP. *Jean-Sebastien Coste;* ***T.A.S. Selmi****; P. Chambat; Ph. Neyret*

Introduction: The goal of this study is to precise the functional and radiological results of an ACL graft at very long-term follow-up, when a meniscectomy was performed before or during the operation.

Material and method: In 1994, 92 patients who had undergone a Dejour's operation (1/3 free BTB associated with an extra-articular tenodesis) associated with a meniscectomy were reviewed. In 1999 we evaluated the functional result (IKDC form) for 64 of these patients and the radiological result (Lachman active and passive (telos) comparative AP view at 45° flexion and profile view) was obtained in 56 cases. The mean age of the patients at operation was 24 years.

Results: At review the mean age was 44 years and the mean follow-up was 17.3 years. Subjective results: 83% of the patients were very satisfied or satisfied. Ligament evaluation: A: 10.2% B: 44.9% C: 36.7% D: 8.2%. At final evaluation (IKDC score) we achieved: A: 8.5% B: 35.6% C: 44.1% D: 11.9%. Radiologically we find: A: 32.6% B: 22.4%; narrowing $<$ 50% 18.4%, narrowing $>$ 50%, 26.6%. Since last revision the number of cases with narrowing $>$ 50% have increased (in 1994: 15.2%, in 1999: 26.6%). The onset of OA is statistically correlated ($p<0.01$) with a medial meniscectomy realized during and even more before the operation. Since Dejour's operation 5 patients had undergone a HTO.

Discussion: In this series with 17 years' follow-up the significant proportion of pre-arthritis and arthritis (45%) can be explained by a really significant residual laxity (45% of C or D score) with a medial meniscectomy always performed.

Conclusion: This study confirms the high rate of radiological degenerative changes between 10 and 17 years' follow-up in case of ACL graft in a medial meniscectomized knee.

184. SEPTIC ARTHRITIS FOLLOWING _ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A RETROSPECTIVE CASE-CONTROL STUDY OF RISK FACTORS AND OUTCOMES. ***David M. Lintner, MD****; Taylor Brown, MD; Walter R. Lowe, MD*

Infections after ACL reconstruction are unusual, but can cause significant morbidity. The objective of this study was to determine the incidence of deep infection following arthroscopic ACL reconstruction as well as the outcome following aggressive treatment of these infections.

Methods: One thousand eight hundred and three consecutive arthroscopic ACLR from 1994 to 1999 were reviewed to determine incidence and risk factors for post-operative infection. Also, treatment and clinical outcomes were evaluated. Inclusion criteria were development of a culture-positive intra-articular infection within 6 months of the arthroscopic ACLR. Twenty-one cases (1.16%) met these criteria. These were compared to the entire group. In addition, forty-two controls, matched by surgeon and year, were selected randomly for more detailed comparison. The ages and gender of controls were the same as the entire ACLR population. Five additional patients presented in a manner similar to those with documented infections but were excluded from the study, as no cultures were positive.

Results: All patients grew only one organism. These were Staphylococcus epidermidis (12), S. aureus (5), Serratia marescens (2), Enterobacter cloacae (1), and Enterococcus (1). There was a trend toward increased incidence of infection in younger male patients, patients who underwent a concomitant procedure (logistic regression to 95% confidence intervals, p value 0.125, 0.123 respectively) and in those knees aspirated for persistent "benign" swelling between initial reconstruction and presentation of infection. There was no difference in incidence of infection based upon graft source (patella tendon or hamstring), fixation type or number of implants, or administration of postoperative intravenous antibiotics.

The cases required an average of 2.0 arthroscopic irrigation / debridements plus intravenous antibiotics for an average of 6.3 weeks, with more debridements and longer antibiotic therapy being required for bowel flora.

Grafts were retained in thirteen of twenty-one cases, and there was similar ligamentous stability between groups if the graft was preserved. Of the eight whose grafts were removed, three have undergone repeat reconstruction without complication and two others returned to competitive sports (volleyball, softball) without a functioning graft. Cases had equal extension but lacked 6 degrees of flexion and achieved these ranges three weeks later. Return to normal daily activity was within one week between groups, but cases returned to work eleven weeks later. The percentage of patients that returned to previous levels of sport was similar between groups, but those with infections took 3 weeks longer to do so.

Conclusions: The incidence of infection was low in this population with Staphylococcal organisms being most common, and the grafts were retained in most cases. Return to pre-injury activities was of similar frequency but slightly delayed in the infected cases. With aggressive diagnosis and treatment, return to activities parallels that of the uncomplicated procedure but with a slightly prolonged course.

185. ONE-INCISION ARTHROSCOPIC ANTERIOR LIGAMENT RECONSTRUCTION USING PATELLAR TENDON AUTOGRAFT: A TEN YEAR FOLLOW-UP. ***Alwin Jaeger****; F. Welsch; C. Kappler*

Purpose: The rupture of the anterior cruciate ligament may lead to recurrent injuries which compromises intra-articular structures as cartilage and menisci as well. Thus, the reconstruction of the anterior cruciate ligament should restore the stability of the knee joint. The purpose of our retrospective designed study was to assess the results of the first 75 consecutive patients, who underwent an arthroscopic anterior cruciate ligament reconstruction. The patients were evaluated after a mean follow-up time of 10 years (range 102 - 132 months).

Method: In every patient the reconstruction was performed in a single-incision endoscopic technique using the central third of the patellar ligament. Interference screw fixation was used in all patients. The tibial fixation was performed with the knee in full extension followed by early range of motion and weight-bearing. Evaluation including physical examination, KT-1000 arthrometer measurements, the IKDC, Lysholm, and Tegner scoring.

Results: The postoperative physical examination and the KT-1000 arthrometer testing were statistically improved comparing to the preoperative findings. A negative pivot shift test was found in 87% and a 1+ in 13% of the patients. There was no 2+ or 3+ pivot shift test seen. 72% had a < 3 mm side-to-side difference on the maximum manual testing. The IKDC score showed an A in 61%, a B in 28% and a C in 11% of patients. The mean Lysholm score was 91.1% (range 67-100) and the Tegner activity improved significantly compared to the preoperative level. The reoperation rate for a symptomatic lack of extension was 12% (9 patients). Patellar tendinitis as a sign of the donor site morbidity was present in 8% (6 patients) within a period up to 6 months after surgery.

Conclusion: The results of the current study indicate that a postoperative evaluation after anterior cruciate ligament reconstruction using bone-patellar tendon autograft in combination with an early range of motion and weight-bearing at a mean follow-up of ten years provide reliable stability, and very good functional testing results.

186. ELECTROTHERMAL TIGHTENING OF CHRONIC PARTIAL ACL TEARS. ***Stephen Houseworth, MD, FACS***

Purpose: To report initial results of electrothermal tightening of chronic partial ACL tears.

Methods: Electrothermal energy has been used to treat various soft tissue abnormalities. The radiofrequency device from Oratec Int. (Menlo Park, California, USA) was used to treat chronic partial tears of the anterior cruciate ligament in patients with symptomatic instability. Each of these patients had undergone an MRI which reported to be "normal." This series includes both partial tears/attenuation of patellar tendon ACL grafts.

Results: A very carefully selected group of 13 patients have undergone this arthroscopic procedure. Each of the patients underwent a detailed and cautious post operative physical therapy program. Each patient has regained full functional stability and have been pleased with their results.

Conclusion: Electrothermal tightening of chronic partial ACL tears appears to be efficacious in a carefully selected group of patients. Further follow-up is needed to assess the long-term results.

187. A NEW DEGRADABLE POLYURETHANEUREA AUGMENTATION DEVICE FOR ACL RECONSTRUCTION. ***Lars Peterson****; Ulf Eklund; Elisabeth Liljensten; Katrin Gisselfält; Anders Lindahl*

Introduction: Early weight bearing, range of motion (ROM) and functional training with preserved stability are some goals after anterior cruciate ligament (ACL) reconstruction. Secondary laxity and progressive instability may follow too early and aggressive rehabilitation after ACL reconstruction. Different types of non-degradable augmentation devices have been tried through the years. A degradable artificial device may improve the stability by protecting the ACL-graft during the first year and allow a more aggressive rehabilitation. A degradable ACL augmentation device has been designed on the basis of a hydrolysable polyurethane urea. Patients with an isolated ACL instability have been reconstructed with a bone-patella tendon-bone (BPTB) autograft augmented with such device.

Materials and Methods: *Chemical composition, fibre spinning and band weaving*: The polyurethaneurea (PUUR) was synthesised by a two-step reaction in N,N-Dimethylformamide (DMF) using polycaprolactonediol, 4,4'-diphenylmethane diisocyanate and 1,3-diaminopropane. The PUUR solution produced in the chain extension reaction with 1,3-diaminopropane was extruded through a spinerett into a precipitation bath of water. In a second bath the fibres were drawn 400-600% before they were collected on a final take up unit. The wet spun multifilament fibres were woven to bands.

Patients and Surgical procedure: Twenty patients with a mean age of 27 years (16-40) were included in a pilot study approved by the Ethics Committee at the Medical Faculty, Gothenburg University. The patients had an isolated ACL instability with a side-to-side difference of 3mm or more on KT-1000 testing. Arthroscopic ACL reconstruction was performed using a BPTB autograft augmented with the device (Fig. 1a and 1b). Interference screws in femur and tibia were used for fixation. Immediate mobilisation with ROM and quadriceps training and weight bearing in a brace was allowed. The patients were evaluated by KT-1000, clinically and by questionnaire. *Biopsy*: From one treated patient (male, age 28 years) a biopsy was taken after 2 years and 9 months in association with an autologous chondrocyte transplantation to an earlier diagnosed cartilage injury. The biopsy was fixed in buffered formaline (4%) in room temperature for 48 hours, dehydrated and embedded in plastic resin. Thin sections (approximately 2 μm) were prepared with a microtome. The sections were consecutively prepared longitudinally from the surface of the biopsy through the entire biopsy. The majority of the sections were stained with toluidine blue and hematoxylin & eosin (H&E). Additionally, some sections

from different levels of the biopsy were used for immunohistochemical identification of collagen type I using rabbit polyclonal antibodies and diamino-benzidine stain.

Results: *Clinical results*: All patients have been followed-up for 30-36 months. Subjective and clinical evaluation revealed stable knees with no pathologic difference on KT-1000 tests. However, four patients had complications directly related to the surgical technique, although this did not negatively effect the knee joint stability. To eliminate the complications associated with the surgery, the operation technique was improved.

Histology: In figures 2a and 2b, the residual material of the PUUR fibres can be seen. Ingrowth of connective tissue is visible between the PUUR fibres. In several sections, the connective tissue shows an orientation parallel with the PUUR fibres. In figure 3, a close contact between the connective tissue and the residual PUUR fibres can be seen. Only few scattered inflammatory cells are present in the section and no evidence of foreign body reaction is seen. In figure 4, the presence of collagen type I can be observed. Vascular ingrowth was seen in different levels of the biopsy.

Conclusions: In the reconstruction of anterior cruciate ligaments, augmentation of BPTB autografts with a new degradable PUUR device allows early ROM-training, weight bearing and functional training with preserved stability. The complications that occurred were related to the surgical technique. The results from the histological analysis revealed a high degree of tissue ingrowth between the PUUR fibres. No indications of severe inflammatory reactions or foreign body reactions were observed. The presence of collagen type I was demonstrated using polyclonal antibodies.