performed to include healthy knees without high degrees of joint wear or associated ligamentous injuries. The lateral menisci were circumferentially implan-
ted with radiopaque spherical markers. They were mounted to a testing apparatus applying muscle and ground-reaction forces. The meniscus was evalu-
ated at 0, 30, 90, and 120 degrees of knee flexion using Roentgen stereoo-
photogrammetric analysis (RSA) and with a second method using two markers put on the posterior cruciate ligament and the lateral meniscus, and the load distribution were assessed using a pressure mapping sensor system after applying a loading force of 200 N to the knee joint. Measurements were recorded for 4 states: the native lateral meniscus, the injury of the lateral meniscus-tibial liga-
ment, the primary repair of the mentioned ligament, the injury of the lateral meniscus-tibial ligament without repair but performing the arthroscopic tech-
nique of capsulodesis. Both cyclic loading and load-to-failure testing were per-
formed. The displacement, stiffness, response to cyclic loading, and mode of failure were recorded and analyzed statistically. Results. The maximum values of extrusion occurred at 60 degrees of flexion, during biomechanical testing, the mean absolute meniscal extrusion at baseline was 1.3 ± 0.5 mm. After creation of the meniscocentral ligament lesion, the mean absolute meniscal extrusion was significantly increased (3.7 ± 0.9 mm) (P < 0.001). After repair, the extrusion was reduced to 1.8 ± 0.4 mm and after the capsulodesis the extrusion was reduced to 2.0 ± 0.5 mm. There were no statistically significant differences be-
tween the results of these last two groups. The average contact pressure of the tibial cartilage was significantly higher in the injury group than in the intact group or the primary repair and capsulodesis group. Conclusions. This study indicates that the lateral menisco-tibial ligament contributes to meniscal stability restricting the radial mobility of the lateral meniscus as lesions cause the meniscus to extrude and that repair of these ligaments and the capsulodesis technique can significantly reduce extrusion.

Category: Knee · Meniscus

Prospective Long-Term Outcomes of The Medial Collagen Meniscus Implant Versus Partial Medial Meniscectomy: A 20-Year Follow-Up Study

Abstract ID# 21996
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Summary:
Differently from the 10 years follow-up, the clinical and the radiological out-
comes of the medial CMI were not superior compared to the patients who un-
derwent meniscectomy.

Data:
Background: The collagen meniscal implant (CMI) is a biologic scaffold that could be used to replace the meniscus host tissue after partial meniscectomy. The short-term results of this procedure have already been described, however, there is a paucity of comparative long-term studies. Purpose: The aim of the study was to compare the clinical outcomes, failures and osteoarthritis progression of pa-
tients who underwent partial medial meniscectomy and partial meniscus scaffold implantation. Study design: Prospective cohort-study; level of evidence, 2.

Methods: Thirty-six nonconsecutive patients with medial meniscal injuries un-
derwent medial CMI (MCMI) implantation or partial medial meniscectomy (PMM) between 1997 and 2000 and were included in a prospective study with an intermediate 10 year follow-up examination. Outcome measures at the last follow-up included the Lysholm score, visual analog scale (VAS) for pain, Inter-
national Knee Documentation Committee (IKDC) knee form, and Tegner activity level. Bilateral weightbearing radiographs were also completed at final follow-up to evaluate Hip-Knee-Angle (HKA), medial Joint Line Height (JL) and the medial joint line difference between the medial joint line angles. Data regarding complica-
tions and failures were collected. Results: At the final follow-up, 31 patients (15 MCMI, 16 PMM, 83% follow-up rate) were included in the final analysis at 21.3 years of follow-up. Two failures (1 per group) were reported: 1 Total Knee Arthroplasty and one medial meniscus transplant, therefore, the survival rate of the CMI was 93%. When comparing the clinical results of the two groups, no difference was found considering the Lysholm score (p = 0.86), KOOS subscales (p = 0.45 – 0.92), Tegner (p = 0.29) and the IKDC (p = 0.70). Moreover, 17 patients underwent Radiographic examination (7 MCMI, 10 MM) and no significant difference was reported with respect of the presence and incidence of Osteoar-
thritis between the two groups. Conclusion: The CMI implant for partial medial meniscectomy provided good long-term results and a low failure rate. However, differently from the 10 years follow-up, the clinical and the radiological out-
comes were not superior compared to the medial meniscectomy group.

Category: Knee · Meniscus

Needle Arthroscopic Repair of Meniscal Tears Under Local Anesthesia: Patient Experience and Outcome Compared to the Traditional Approach

Abstract ID# 22377
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Summary:
Needle arthroscopic repair of meniscal tears under local anesthesia is safe and yields clinical outcome equal to more invasive traditional approaches, with less postoperative pain and less time spend on the surgical floor.

Data:
Purpose To compare patient experience and outcome of needle arthroscopic all-
inside repair of meniscal tears using only local anesthesia with the traditional arthroscopic approach. Methods This was a pragmatic, prospective and comparative trial including 20 consecutive adult patients that suffered a tra-
umatic meniscal tear in the red or red-white zone – equally divided between an innovation study arm and a control arm. In the innovation arm, procedures were performed using needle arthroscopy under local anesthesia. In the control arm, procedures were performed with traditional arthroscopy and under general or spinal anesthesia. Participants were allocated to a study arm based on shared decision making. The Hospital Anxiety and Depression Scale (HADS, 0–42, lower is better), Numeric Rating Scales (NRS, 0 – 10) of pain and satisfaction, use of pain medication (in addition to acetaminophen) and a Net Promotor Score (NPS, 0 – 10) were collected at baseline prior to the procedure, at discharge and at 1-
day, 2-days, 7-days, 6-weeks and 3-months post-op. The KOOS domains, EQ5D-
Qol and return to work were collected at baseline and 3-months post-op. Pain during the procedure was collected for needle arthroscopy patients, and pro-
cedure times for all participants. Occurrence of (serious) adverse events was monitored during the entire study. An a-priori power calculation with the baseline HADS as primary outcome measure indicated that 10 patients should be included in each group in order to detect a five-point difference between both groups. Results 20 patients were included in each group. Mean age was 34 in the needle arthroscopy arm and 37 in the traditional arm (t = 0.55, p = 0.59). Patients in the needle arthroscopy group experienced a lower NRS of pain at discharge compared to the traditional arthroscopy group (2 vs 7, p = 0.048), and less needle arthroscopy group participants used pain medication (in addition to acetaminophen) at discharge (2 vs 8 patients, p = 0.003) and at postoperative day 7 (4 vs 8 patients, p = 0.012). The EQ5D-Qol at 3 months post-op was higher in the needle arthroscopy group (80 vs 70.5, p = 0.041). Median NRS of pain during the needle arthroscopic procedure was 2 (IQR 1 – 6). At 3-month follow-up, there were no differences in HADS, NRS of pain, NRS of satisfaction, NPR, return to work, the KOOS domains, use of pain medication and ability to walk without supportive devices. Surgical time was longer in the needle arthroscopic group (27 vs 14 minutes, p = 0.003), yet time between arrival in the OR and discharge to the ward was longer in the traditional group (53 vs 92 minutes, p = 0.003). One pa-
tient from the traditional group was converted to a meniscectomy 9 months after the index procedure. There were no further complications. Conclusion This study indicates the feasibility of needle arthroscopic repair of meniscal tears under local anesthesia. In well selected and counseled patients, patient experience and outcome – including anxiety, satisfaction, pain and quality of life – is equal to the traditional arthroscopic approach. Postoperative pain and use of pain medication may be less and patients spend less time on the capacity constrained operative floor.

Category: Knee · Meniscus

Arthroscopic Capsulodesis Decreases Meniscal Extrusion At 1 Year Follow Up When Combined With Transtibial Repair of Posteroemedial Root Lesion. A Multicenter Prospective Randomized Study

Abstract ID# 22575
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Summary: Adding a capsulodesis to transtibial postero-medial root repair, we can decrease the meniscal extrusion at 1 year follow up.

Data:

The aim of the present study was to assess whether arthroscopic capsulodesis associated with transtibial postero-medial repair may reduce the meniscal extrusion that is frequently associated with the clinical failure of this kind of repair. Method: a multicenter randomized prospective study including patients with isolated lesions of the postero-medial meniscal root was performed. Only root lesion of type 2 and 4 according to LaPrade classification were included. Exclusion criteria were: varus knee > 4º and joint degeneration grade > 2 according to the Kellgren-Lawrence classification, BMI > 35. Power analysis was carried out using as primary outcome the difference in meniscal extrusion: 10 patients per group were enough for a power > 80%. We included 11 patients per group considering 10% of possible dropouts. The 22 patients were randomized: in group 1 a transtibial root repair was performed, in the group 2, in addition to the same repair, an arthroscopic capsulodesis was performed. A prospective follow-up by MRI at 3,6,12 months to assess meniscal extrusion was made. All measurements were performed by two different observers. For each case, measurements were taken twice, keeping the result of the first measurement blind. Inter and intra class agreements were calculated. The meniscal extrusion was calculated in coronal images at the maximum point of extrusion. Measurement was performed drawing two lines: one vertical line intersecting the peripheral margin of the lateral tibial plateau (LTP) at the point of transition from horizontal to vertical. A second perpendicular line was drawn from the outer margin of the meniscus to the former line to measure the degree of extrusion. Additionally, when the graft was extruded less than 3 mm beyond the LTP, it was considered minor extrusion, conversely, major extrusion was considered when the meniscus more than 3 mm of subluxation. Results: the intraclass correlation coefficient obtained was considered excellent (0.89; 95% CI: 0.84-0.92) and the high calculated k coefficient (0.78; 95% CI: 0.62-0.84) showed excellent agreement between observers. No differences were detected in preoperative meniscal extrusion (group 1 28.35 ± 11.28 mm VS group 2 27.12 ± 12.37 mm; p = 0.342). The meniscal extrusion in group 2 was lower both at 6 and 12 months postoperative (p = 0.019). In both groups at 12 months, preoperative extrusion decreased (p = 0.005). Preoperatively in 8 cases of group and 9 cases of group 2 presented major extrusion (p = 0.965) whereas at 12 months postoperatively major extrusion was detected in 7 cases of group 1 and in 3 cases of group 2 (p = 0.031). Conclusion: Arthroscopic capsulodesis limits meniscal extrusion at 1 year follow up when associated with transtibial repair of a postero-medial root tear. Longer-term clinical follow-up is needed to understand the clinical impact of this radiological finding.

Category: Knee · Meniscus

Biomechanical Comparison of Lateral Meniscus All-inside Radial Repair Techniques in a Cadaveric Model

Abstract ID# 23471
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Summary: This study evaluated biomechanical properties of four all-inside, meniscus-based repairs to radial tears of cadaveric human lateral menisci and found that reinforcing vertical suture meniscus repairs with horizontal suture significantly increases load to failure.

Data: Introduction Meniscal injuries are among the most common orthopedic injuries in the United States. Radial meniscus tears were historically treated with partial meniscectomy, often leading to poor outcomes. Repairing radial tears preserves meniscal tissue, may delay knee degeneration, and leads to better long-term outcomes. Repair techniques for radial tears vary and should be evaluated for differences in biomechanical properties and failure mechanisms.1-3 All-inside, meniscus-based suture repairs have shorter operating times, minimize risk of nerve injury, and are increasingly possible with novel devices.3 Objective Our objective was to evaluate four all-inside techniques to repair radial tears in human cadaveric lateral menisci. We chose two techniques – the Double Vertical (DV) and Double Vertical Cross (DVX) – that bridged the tear directly. We chose two other techniques – the All-inside Rebar (AR) and our novel Oblique Box (OB) – that added reinforcing stitches to engage the bridging stitches. We hypothesized that AR and OB would have higher load to failure than DV and DVX. Methods 36 fresh-frozen lateral human menisci were randomized into four groups of nine. A complete radial tear was created at the midbody of the meniscus. Suture repairs were performed using 2-0 braided suture. We repaired the menisci using the DV, DVX, AR, and OB techniques with meniscus-based suturing to simulate the all-inside, meniscus-based approach with all knots tied on the superior surface of the menisci. The DV repair used two sutures in loops perpendicular to the tear. DVX used two sutures in loops that crossed over the tear. AR used two sutures in loops parallel to the tear acting as reinforcing rebar and two bridging sutures perpendicular to tear and outside rebar sutures. OB used two sutures to create a trapezoidal reinforcing box on either side of the tear and two bridging sutures in loops perpendicular to tear and inside the box. The repaired menisci underwent load to failure testing and were analyzed statistically. Results Failure occurred due to suture cutout. Repair constructs that lacked a reinforcing-type suture (DV and DVX) cut through or “cheese-wired” at lower loads than repairs with reinforcing sutures (AR and OB). The AR repair sustained the highest load to failure, nearly 3x stronger than the two non-reinforcing type repair constructs. Mean load-to-failure values for each repair group were 60 N ± 24.5 for DV, 58 N ± 17.4 for DVX, 168 N ± 33.9 for AR, and 105 N ± 9.0 for OB. These results show that reinforcing vertical suture meniscus repairs with some type of horizontal suture (e.g. AR or OB) significantly increases load to failure for all-inside, meniscus-based techniques. Conclusions In a cadaveric lateral meniscus model, all-inside radial repairs using rebar suture techniques had higher ultimate load to failure and reduced risk of “cheese wiring”. These data may provide useful information for surgeons to consider when deciding how to repair radial meniscus tears to maximize patient outcomes. Future biomechanical study should compare all-inside vs. inside-out repairs. Clinical outcomes of these various all-inside radial repair techniques are also critical.

Category: Knee · Meniscus

Medial meniscus posterior root repair delays but not avoids histological progression of osteoarthritis: randomized in vivo experimental study

Abstract ID# 21765
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Summary: Medial meniscus posterior root repair delays but not avoids histological progression of osteoarthritis: randomized in vivo experimental study

Data: Objective: The purpose of this study was twofold: (1) to describe and compare histopathological results of 3 different treatment options: nonoperative management, partial meniscectomy, and meniscal root repair and (2) to test the hypothesis that radial meniscal root tears treated conservatively predispose to a lower risk of osteoarthritic progression compared to partial meniscectomy. Study Design: Prospective, randomized, and experimental study. Methods: Posteromedial meniscal root tears were carried out in 39 NZW rabbits. The animals were randomly assigned into three experimental groups: partial meniscectomy after root tear (PM, n = 13); root tear left in situ (CT, n = 13); and transtibial root repair (RR, n = 13). Contra-lateral limbs were used as healthy controls. The animals were euthanized at 16 weeks postoperatively; tissue samples of femoral and tibial articular cartilage were collected and processed for macro and microscopic assessment to detect signs of early osteoarthritis (OA). Each sample was histopathologically assessed using the AORSI grading and staging system. Results: Osteoarthritic changes were the hallmark in all three experimental groups. The