patients with severe osteoarthritis. Conclusions: Arthroscopic debridement and capsular release provided relief of pain for an average of over nine months even in cases of severe osteoarthritis. Patients with moderate osteoarthritis had a good functional outcome after surgery and their results were superior to those with severe degenerative changes. Based upon these results, arthroscopic debridement and capsular release appears to be beneficial in the treatment of mild and moderate glenohumeral osteoarthritis.

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Load Bearing at the Menisco-Femoral Joint: An In Vitro Study in the Canine Knee (SS-22)

The purpose of this study was to determine the contact areas (CA) and local contact stresses (LCS) at the canine menisco-femoral joint during ROM, and to determine the influence of a partial or total meniscectomy. Materials: Both knees of 3 hound-type canines were tested in a universal testing machine, configured for an axial-load of 90-120 N. Measurement of CA and LCS was done at 30°, 50°, and 70° and with intact menisci, after partial meniscectomy, and after total meniscectomy. Pressure distribution was estimated using pressure sensitive film inserted above the menisci. Results: Medial meniscus at 50°: the average CA decreased from 2.1 cm^2 in the intact knee, to 1.6 cm^2 after partial meniscectomy, to 0.5 cm^2 after total meniscectomy; the average LCS increased from 1.3 MPa in the intact knee, to 1.7 MPa after partial meniscectomy, to 2.1 MPa after total meniscectomy. Medial meniscus at 30°: the average CA decreased from 1.7 cm^2 in the intact knee, to 1.3 cm^2 after partial meniscectomy, to 0.4 cm^2 after total meniscectomy; the average LCS increased from 1.2 MPa in the intact knee, to 1.5 MPa after partial meniscectomy, to 2.5 MPa after total meniscectomy. Medial meniscus at 70°: the average CA decreased from 2.4 cm^2 in the intact knee, to 1.7 cm^2 after partial meniscectomy knee, to 0.5 cm^2 after total meniscectomy; the average LCS remained at 1.7 MPa in the intact knee and after partial meniscectomy, but increased to 2.3 MPa after total meniscectomy. Lateral meniscus at 50°: the average CA decreased from 3.3 cm^2 in the intact knee, to 2.4 cm^2 after partial meniscectomy knee, to 0.7 cm^2 after total meniscectomy; the average LCS remained at 1.5 MPa in the intact knee and after partial meniscectomy, but increased to 2.9 MPa after total meniscectomy. Lateral meniscus at 30°: the average CA decreased from 3.0 cm^2 in the intact knee, to 2.3 cm^2 after partial meniscectomy, to 0.5 cm^2 after total meniscectomy; the average LCS remained at 1.3 MPa in the intact knee and after partial meniscectomy, but increased to 2.4 MPa after total meniscectomy. Lateral meniscus at 70°: the average CA decreased from 3.2 cm^2 in the intact knee, to 2.4 cm^2 after partial meniscectomy, to 0.8 cm^2 after total meniscectomy; the average LCS increased from 1.4 MPa in the intact knee, to 1.6 MPa after partial meniscectomy, to 2.9 MPa after total meniscectomy. These differences were statistically significant ($P < .05$). Conclusions: Partially excised menisci offer a sufficient "spacer effect" to protect the femoral cartilage. The contact area and local contact stress differ minimally, both in the intact knee and after partial meniscectomy, when tested with low loads during physiologic gait. A dramatic decrease of contact area followed by an increase of local contact stress was noted after total meniscectomy.

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Biomechanical Effects of Meniscal Repair Techniques on Articular Contact Pressure at Various Knee Flexion Angles (SS-23)

Objective: Articular cartilage injury can occur after meniscal repair with biodegradable implants. Previous contact pressure analysis of the knee have been based on the tibial side of the meniscus at limited knee flexion angles. We investigated articular contact pressures on the posterior femoral condyle with different knee flexion angles and surgical repair techniques. Methods: Medial meniscus tears were repaired in 30 fresh bovine knees (10 suture, 10 biodegradable screw implant, 10 biodegradable arrow implant). Knees were mounted on a 6 degrees-of-freedom jig and statically loaded to 200 N at 45, 70, 90, and 110 degrees of knee flexion under three conditions: normal meniscus, with 2 cm posterior medial meniscal vertical tear, and after repair of tear. For each repair, three sutures or biodegradable implants were used. A Tekscan pressure sensor was used to determine the contact area and peak pressure. Peak pressures over each implant position were also measured. Statistical analysis was preformed using the ANOVA test and $P < .05$ defined statistical significance. Results: Peak pressure increased significantly as knee flexion increased in normal, injured, and repaired knees. The change in peak pressure in knees with implant repairs were significantly higher than suture repairs at all knee flexion angles. The most medial and/or middle implant had higher peak pressures among the 3 implants, but statistical significance was found only with the biodegradable screw. Conclusions: Articular contact pressure on the posterior femoral condyle increases with knee flexion. Meniscal

repair with biodegradable implants showed higher peak pressure than suture repair, particularly at the most medial location. Implants in the more posterior meniscus demonstrated smaller increases in peak pressure, and may have less potential for articular cartilage injury. These results suggest that avoidance of deep knee flexion angles postoperatively may limit increases in articular contact pressures and potential chondral injury.

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Meniscal Fixation Implants Sufficiently Reduce Gapping of Longitudinal Meniscal Tears (SS-24)

Many meniscal fixation implants provide only low pull out forces between 15 and 50 N. However, it is unknown if these forces are sufficient to withstand the loads, which occur in vivo. The aim of this laboratory study was to explore the gapping behavior of longitudinal meniscal tears. It was also investigated to what extent a fixation implant of low pull out force is able to reduce the gaps that occur in meniscal tears under different loading conditions. Methods: Longitudinal tears of 2 cm in length were set in the posterior horn of the medial menisci of 8 porcine knee joints. To observe the tears an opaque placeholder of the same shape as the original articular surface replaced the medial tibial plateau. Thus the menisci could be visualized in situ. The knees were exposed to flexion-extension cycles in a loading and motion simulator under 30 N and 200 N axial joint load, under tibial rotation moments, varus or valgus moments, and combined moments. For each load condition the maximum gap width of the tear occurring during a motion cycle was recorded. All tests were repeated after lengthening the initial tear to 2.5 cm, and subsequently to 3 cm. Finally the tears were repaired using three Meniscal Screws in each knee and the test repeated. Results: Maximum gapping of 1.6 mm (Standard deviation (SD) 0.5 mm) occurred for the 3 cm tear under 200 N axial joint load under a valgus-external tibial rotation moment. Significantly less gapping was observed under pure internal tibial rotation for all tear lengths and axial loads (between 0.1 mm (SD 0.28 mm) and 0.9 mm (SD 0.3 mm); $P < .05$). Longer tears always produced broader tear gaps ($P < .05$). Repair with three Meniscal Screws reduced the maximum width of the tear gaps significantly ($P < .05$). The gaps were very small especially at the locations of the implants with gap widths of 0.28 mm (SD 0.45 mm) under a varus moment and 200 N axial joint load. The gapping between the implants was also reduced with a maximum gap of 0.62 mm (SD 0.52 mm) under external tibial rotation and 30 N axial joint load. Discussion: From the gap widths measured in this study and the stiffness of the implant-meniscus interface determined in previous studies maximum forces of the implant-meniscus interface of 10 N can be estimated. This coincides with the findings of Kirsch et al. (J Biomech 1999;Suppl 1:104), who measured low forces in meniscal sutures. Therefore the implant pull out force seems not to be a critical parameter. In conclusion, it can be assumed that all available meniscal fixation implants provide sufficient primary stability avoiding excessive gapping even under critical joint loads like valgus and external tibial rotation. Early rehabilitation under weight bearing can therefore be recommended. Nevertheless, to avoid peak gapping of repaired meniscal tears a brace limiting external rotation can be worn.

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Complex and Horizontal Cleavage Meniscal Tears: Association With Significant Cartilage Damage (SS-25)

Experimental studies demonstrated that meniscal tears could lead to chondropathy and osteoarthritis. Clinical studies are controversial. Some authors describe the association of meniscal and articular cartilage lesions as coincidental, whereas others believe that causal link may exists. Some studies suggest that stable tears have good potential for healing and are less likely to produce osteoarthritis. Even though there are not a lot of studies to support this fact, complex tears and horizontal cleavage tears have been considered degenerative tears associated with cartilage degeneration. The objective of the present study was to evaluate whether horizontal cleavage and complex meniscal tears are associated with more significant cartilage damage, in comparison with patients having other pattern of meniscal injury. Data were collected prospectively from 1,000 consecutive knee arthroscopies. Of the 1,000 patients who had knee arthroscopy, 507 (50.7%) patients had meniscal tears and mainly these patients were included in this study. There were 359 men and 148 women with age 13 to 85 years (mean age 40.8 $\pm$ 15.2 years). Of these patients, 333 (65.6%) had medial meniscal tears and 184 (34.4%) had lateral meniscal tears. Patients details (age, sex, duration of symptoms, injuries, and possible mechanism of injury), operative details (types and number of portals, equipment used), intra-articular findings (articular, meniscal and synovial lesions, and stability characteristics) and procedures performed were recorded. Pathologic findings were recorded diagrammatically, with articular lesions being represented on accurate anatomic maps of the articular