Predictors of Complications and Re-operation After Knee Cruciate Ligament Reconstruction in Ontario 1992-2008

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Objectives:
Factors that contribute to early and late re-operation after cruciate reconstruction ("CR") have not been evaluated on a population level in a public health system. Knee stiffness, infection or early graft failure may precipitate early re-operation. Long-term, ipsilateral revision CR, contralateral CR and potentially joint replacement may occur. Population data from total joint replacement surgery demonstrated an inverse relationship between complication/failure rates and surgeon procedural volume. We hypothesized that lower surgeon volume would increase the risk of short and long-term re-operation after CR.

Methods:
Billing, procedural and diagnostic coding from administrative databases were used to develop the cohort of all Ontario residents aged 14 to 60 who underwent anterior or posterior CR from July 1992 - April 2008. Logistic regression analysis was used to calculate the odds ratio for patient factors (age, gender, comorbidity, income, concurrent knee surgery) and provider volume for having a surgical knee washout, manipulation for stiffness or repeat CR within six months. A cox proportional hazards survivorship model was used to calculate the hazard ratio of the same covariates for repeat CR and partial/total knee arthroplasty from inception until end of 2009.

Results:
The CR cohort contained 34,735 patients with a median age 28 yrs (IQR 20-36) and 65% male. Re-operation was 0.2% for infection and 0.5% for stiffness. The long-term rate of any repeat CR was 7.7% after a mean 4.2±3.4 years. Female gender (OR=2.8, p<0.0001), overnight hospital stay (OR=2.1, p=0.0005), meniscal repair with CR (OR=1.9, p=0.008) and surgeon volume of 0-12 CR/yr (OR=4.0, p=0.0006), significantly increased the odds of re-operation for stiffness. Only surgeons performing 0-12 CR/yr (OR=3.8, p=0.007) was a risk factor for infection. Repeat CR was not influenced by surgeon volume, however, survival analysis demonstrated an increased risk (HR=1.8, p<0.0001) in patients aged 14-19 yrs compared to the mean cohort age. Subsequent partial or total knee replacement occurred in 0.75% of patients, influenced by patients >30 years (HR=2.5, p=0.002), or who had concurrent surgery for an osteochondral lesion at the index CR (HR=2.3, p=0.001).

Conclusions:
We have demonstrated that lower volume surgeons have higher complication (infection, stiffness), but not revision rates after CR. We have also identified at-risk groups, such as females for stiffness post-CR and osteochondral injury + CR for eventual knee replacement.

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No disclosure.
What is the Rate of Subsequent Surgery Following ACL Reconstruction? Short and Mid-term Follow-up From the MOON Cohort
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Objectives:
Subsequent surgeries have profound effects on patient satisfaction and outcome following primary ACL reconstruction. There have been no prospective studies to date describing the rate of all subsequent surgeries at short and mid-term follow-up, along with analysis by type of ACL reconstruction and graft choice.

Methods:
971 patients (541 male) were prospectively enrolled in the Multicenter Orthopaedic Outcomes Network from January of 2002 to December of 2003. Two and six- year follow-up for subsequent procedures were obtained in 91.8% and 91.3% of patients, respectively. Operative reports were obtained, and all procedures were recorded.

Results:
There were 241 subsequent surgeries on the ipsilateral leg (24.8%) and 118 on the contralateral knee (12.2%) at 6-year follow-up. On the ipsilateral knee, 19.1% were for arthrofibrosis, 26.1% were revision ACL reconstructions (6.4% of entire cohort), 9.1% had hardware removal, and 31.5% had procedures done to the cartilage or the meniscus. For the contralateral knee, there was a 5.6% rate of primary ACL rupture.

665 of the reconstructions were single incision, 308 were done by 2-incision technique. For the single incision technique 5.4% had subsequent procedures for arthrofibrosis, 2.4% for hardware removal, and 8.3% for cartilage/meniscus, and 7.5% revision ACL reconstructions. For 2-incision technique these were 3.2%, 1.9%, 6.8%, and 4.2% respectively. Of the 971, 464 patients had BTB grafts, 340 hamstrings, and 167 other grafts. BTB had a 3% incidence of subsequent surgery for arthrofibrosis, vs. 8.8% in the hamstring group. 3.7% of the BTB grafts were revised, compared to 7.5% in the hamstring group. For hardware removal, rates for BTB and hamstring were 1.3% and 4.2% respectively.

<table>
<thead>
<tr>
<th></th>
<th>Single Incision (n=665)</th>
<th>Two Incision (n=308)</th>
<th>BTB (n=464)</th>
<th>Hamstring (n=240)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthrofibrosis</td>
<td>36 (5.4%)</td>
<td>10 (3.2%)</td>
<td>14 (3.0%)</td>
<td>21 (8.8%)</td>
</tr>
<tr>
<td>Cartilage/Meniscus</td>
<td>55 (8.3%)</td>
<td>21 (6.8%)</td>
<td>35 (7.5%)</td>
<td>23 (9.6%)</td>
</tr>
<tr>
<td>Hardware</td>
<td>16 (2.4%)</td>
<td>6 (1.9%)</td>
<td>6 (1.3%)</td>
<td>10 (4.2%)</td>
</tr>
<tr>
<td>Revision ACL</td>
<td>50 (7.5%)</td>
<td>13 (4.2%)</td>
<td>17 (3.7%)</td>
<td>18 (7.5%)</td>
</tr>
</tbody>
</table>

Conclusions:
At minimum 6 year follow-up, 24.8 percent of ACLR patients underwent subsequent surgeries on the ipsilateral knee. The ipsilateral vs contralateral ACLR graft vs normal ACL tear was similar (6.4% vs 5.6%). There were observed differences in operative techniques and autograft choice on subsequent procedures. An ongoing multivariable analysis should identify modifiable risk factors to potentially reduce subsequent surgeries. Further research is needed to prevent ACLR graft failure and contralateral ACL tears in the future.

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Survival Comparison of Allograft and Autograft ACL Reconstruction at US Military Academy

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Objectives:
There is recent evidence that use of allograft tendons for ACL reconstruction in young patients may result in increased failure rates compared to autologous grafts. The goal of this study was to evaluate the survival of the different graft options among a closed cohort of active patients.

Methods:
A prospective cohort study of cadets at the US Military Academy was performed to assess performance of ACL reconstructions performed prior to entrance to service. Members of the classes of 2007 through 2013 who had undergone prior ACL reconstruction were identified through DoDMERB reporting and waiver process and evaluated on registration day upon matriculation. These subjects were monitored during their tenure at the academy with revision ACL reconstruction as the primary outcome measure. Comparison of allograft and autograft reconstructions was performed using chi square analysis (p<0.05).

Results:
A total of 117 cadets had complete data available and comprise the prospective cohort. Of these, the grafts used were 62 BTB, 42 hamstring, and 13 allograft. A total of 19 failures occurred among this cohort at an average of 1079 days from primary reconstruction. Of these failures requiring revision, 10 (16%) were BTB, 5 (38%) were allograft, and 4 (10%) were hamstring. This difference between allograft and autograft ACLs was significant (p=0.02).

Conclusions:
In this young active cohort, subjects having undergone an allograft ACL reconstruction were significantly more likely to experience clinical failure requiring revision reconstruction compared to autologous grafts. We recommend the use of autograft in ACL reconstruction in young military personnel.

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The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the Department of Defense or U.S. government.

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Graft Size and Patient Age are Predictors of Early Revision Following ACL Reconstruction with Hamstring Autograft

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Objectives:
Hamstring autografts are frequently utilized for successful anterior cruciate ligament reconstruction. Commonly used 4-strand grafts average about 8 mm in diameter but significant variation among patients has been noted. The ultimate failure load of smaller grafts is lower in biomechanical studies. Failure rates for ACL reconstruction are between 5 and 20% in most series and may be higher in younger patient populations. We hypothesize that decreased hamstring autograft size and decreased patient age are predictors of early graft failure and revision.

Methods:
Two hundred fifty-six of 338 consecutive patients (75.7%) undergoing primary ACL reconstruction with hamstring autograft were retrospectively evaluated. Graft size, patient sex, and patient age at the time of ACL reconstruction were recorded from medical records along with whether each patient underwent revision ACL reconstruction during the follow-up period.

Results:
The 256 patients included 136 males (53.1%) and ranged in age from 11 to 52 years (mean, 25.0 years). Average follow-up was 14 months (range, 6 to 47 months). Revision ACL reconstruction was required in 18 of 256 patients (7.0%) at a mean of 12 months following surgery (range, 3 to 31 months). Revision was required in 1 of 58 patients (1.7%) with grafts greater than 8mm in diameter, 9 of 139 patients (6.5%) with 7.5 or 8 mm grafts, and 8 of 59 patients (13.6%) with grafts 7 mm or less in diameter (p = 0.049). One revision was required in the 137 patients age 20 and older (0.7%), but 17 revisions were required in the 119 patients under 20 (14.3%) (p < 0.0001). Most failures (16 of 18) were noted to occur in patients under age 20 with grafts 8mm in diameter or less. The revision rate in this population was 16.4% (16 of 97 patients). Multiple logistical regression revealed decreased age at reconstruction (OR = 1.25; 95% CI = 1.07-1.45; p = 0.004) and decreased graft size (OR = 2.35; 95% CI = 1.07-5.14; p = 0.032) to be associated with significantly increased risk of revision. Female gender was not noted to be an independent predictor of graft failure when patient age and graft size were taken into account (OR = 1.40; 95% CI = 0.48-4.04; p = 0.53).

Conclusions:
Decreased hamstring autograft size and decreased patient age are predictors of early graft failure and revision. Use of hamstring autografts 8mm in diameter or less in patients under age 20 is associated with a relatively high early revision rate.

Relevant disclosure declaration for all authors:
No disclosure.
**Adverse Events in Medial Opening Wedge High Tibial Osteotomy. A Retrospective Cohort Study of 323 Cases**


**Objectives:**
To examine adverse events and their risk factors in medial opening wedge high tibial osteotomy (MOW HTO).

**Methods:**
All patients receiving MOW HTO at our center from Sept. 2005 to Aug. 2009 were included in this retrospective cohort study, with evaluations at 2, 6, 12 weeks, 6 months and 1 year. Surgical and postoperative adverse events and their hypothesized risk factors were defined a priori. Medical records and x-rays were reviewed by an independent observer.

**Results:**
323 consecutive patients (242 males) were evaluated (age=46±9, BMI=30±5). 82% (n=265) had ASA scores of 1 or 2, 20% (n=65) were active smokers and 4% (n=13) had diabetes. Data from 7% (n=23) were unavailable at 1 year. Mean follow-up was 24 months (min 12; max 52). 16% (n=52) of MOW HTO’s were combined with ACL reconstruction and 1% (n=3) with multi-ligament reconstruction. A non locking Puddu plate was used in 80% (n=259), a locking plate in 17% (n=56) and a PEEK plate in 3% (n=8). Mean wedge size was 12±3mm. 94% (n=303) were filled with cancellous allograft. Adverse events not requiring treatment were undisplaced lateral tibial plateau fracture (3%; n=9), displaced (>2mm) lateral hinge fracture (6%, n=18), delayed wound healing (6%, n=18) and hematoma (3%; n=9). Adverse events requiring non-operative management but not affecting outcome were cellulitis (10%; 31/322), post-op stiffness (1%; 4/314), DVT (1%; 4/314), RSD (1%; 4/314), delayed union (12%; 38/317) and limited hardware failure (1 broken screw; 4%; 12/301). Severe adverse events requiring revision surgery and/or affecting outcome were deep infection (2%; 5/301), neuropathic pain (1%; 3/314), aseptic non union (3%; 10/317) and severe hardware failure with loss of correction (1%; 2/301). Revision surgery rate was 3% (10/300). Multivariable logistic regression showed that risk factors for severe adverse outcomes were diabetes (OR:16; 95%CI:4-65), active smoking (OR:6; 95%CI:2-18), non compliance with partial weight bearing (OR:6; 95%CI:1-30) and displaced lateral hinge fracture (OR:9; 95CI%:2-43).

**Conclusions:**
This comprehensive review suggests the rate of adverse events in MOW HTO requiring revision surgery and/or affecting outcome is low (7%). Attempts should be made to control identified risk factors for these events preoperatively and at time of surgery.

**Relevant disclosure declaration for all authors:**
No disclosure.
Complications of Arthroscopic Meniscectomy in the Older Population

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Objectives:
The purpose of this study to investigate and report complications in arthroscopic meniscectomy in the older population as it has not been well documented in literature.

Methods:
The Medicare Standard Analytic Files database from the years 2005 to 2008 was reviewed and analyzed. Criteria for inclusion included men and women aged 65 years or older who underwent procedures coded as arthroscopic meniscectomy including CPT codes 29880 (medial and lateral meniscectomy) and 29881 (medial or lateral meniscectomy). Among this population, rates of postoperative complications including pyogenic arthritis, deep venous thrombosis (DVT), and pulmonary embolism (PE) were evaluated.

Results:
A total of 314,578 patients (119,814 males and 194,764 females) met the criteria for inclusion. There were 131,420 patients coded 29880 and 183,158 patients coded 29881. For the entire study population 0.4% (1107 patients) developed pyogenic arthritis, 0.8% (2,543 patients) developed a DVT, and 0.3% (992 patients) developed a PE within 90 days of their procedure. Among males, 0.4% developed pyogenic arthritis, 0.7% developed a DVT and 0.2% developed a PE. Among females, 0.3% developed pyogenic arthritis, 0.8% developed a DVT and 0.3% developed a PE. Males had a statistically significant higher relative risk of pyogenic arthritis for both codes and females had a statistically significant higher relative risk of DVT and PE for both codes.

Conclusions:
Although post-operative complications including pyogenic arthritis, DVTs, and PEs are rare, gender differences in post-operative complications exist between men and women aged 65 years or older. Further studies in this population are warranted.

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No Disclosure.
A Matched Case-control Study of Re-operation for Meniscal Repair with and without Concomitant Anterior Cruciate Ligament Reconstruction

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Objectives:
Meniscal tears are typically thought to heal better when performed in conjunction with ACL reconstruction (ACLR). Recent case series report healing as high as 96%1,2 clinically and 85% by repeat arthroscopy3,4. In comparison, original series of meniscal repair in non-ACLR reconstructed knees report success rates closer to 70%5,6. The success of meniscal repair has never been reported or compared directly between patients with and without ACLR on a population level. We hypothesized that the rate of re-operation would be lower when meniscal repair was performed with ACLR.

Methods:
This was a retrospective case-control population level study. Our previous work identified all ACLR in Ontario, Canada from July 2003 - March 2008 in patients aged 14 to 60 by using administrative billing, diagnostic and procedural coding databases. Among this ACLR cohort, we identified the subset of all patients who underwent a meniscal repair in conjunction with ACLR. This “case” group was matched 1:1 to a “control” group of patients of the same gender, age within 5 years and who were operated on during the same study period for a meniscal repair alone. The main outcome was repeat meniscal surgery (debridement or repeat repair) within one year of the index procedure. The number of meniscal repair procedures performed by the surgeon in the year prior to the index event was calculated for each case/control. McNemar’s test was used to calculate a difference in the rate of re-operation between cases and controls.

Results:
We identified 1298 patients in each case and control group. The rate of meniscal re-operation was 4.5% when repair was performed with ACLR and 20.7% when repair was performed alone (p<0.0001). A significantly greater number of the “case” repairs (42%)were performed by the highest volume surgeons (p<0.0001) in comparison to controls (14%).

Conclusions:
These results represent the highest available level of evidence of a direct comparison of meniscal repair with and without ACLR. In general, meniscal repair is statistically and clinically significantly improved when performed in conjunction with ACLR. This finding may be influenced by the fact that more high volume meniscal repair surgeons performed case repairs. Our study design has reduced the influence of patient factors (e.g., age) on healing potential, but is limited to account for other factors such as repair technique, type of tear and chronicity.

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Incidence of Symptomatic Venous Thromboembolism After Knee Arthroscopy

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Objectives:
Venous thromboembolic events (VTE) are a rare but potentially serious complication following knee arthroscopy. The purpose of this study was to determine the incidence of VTE after knee arthroscopy at a single institution, and to determine associated risk factors for VTE in these patients.

Methods:
The records of patients who underwent arthroscopy at a single institution between 1985 and 2005 were reviewed. Confirmed VTE events occurring within 4 weeks following the index arthroscopy procedure were noted. A 2:1 matched control group was generated to include patients for whom knee arthroscopy was performed by the same surgeon either on the same day or immediately prior to each case resulting in VTE. Pre- and perioperative data were collected with respect to demographics, past medical history, medications, and surgical and anesthesia data. Chemoprophylaxis was not routinely used.

Results:
12,595 patients underwent knee arthroscopy during the study period. 43 cases of VTE [35 deep vein thromboses (DVT), 5 pulmonary embolisms (PE), and 3 DVTs that progressed to PE] occurred in 12,595 knee arthroscopy procedures, resulting in an incidence of 0.30% (95% CI 0.22-0.41%) for DVT, and 0.06% (95% CI 0.03-0.12%) for PE. Factors associated with an elevated risk of postoperative VTE included history of malignancy (p=0.01), history of prior VTE (p=0.02; OR=8.9), and the presence of ≥2 classic risk factors for VTE (p=0.04; OR=2.66).

Conclusions:
VTEs occur in 0.34% of knee arthroscopy cases in the absence of routine chemoprophylaxis. Patients with a history of VTE, malignancy, or 2 or more classic risk factors are at increased risk for VTE after knee arthroscopy.

Relevant disclosure declaration for all authors:
No disclosure.
Results after Tibial Tubercle Distalization in Patients with Patella Alta

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Objectives:
We sought to determine the objective and subjective results of surgical patellar realignment with tibial tubercle distalization in patients with atraumatic dislocations, positive J-signs, and patella alta.

Methods:
From 254 patients who underwent patellar realignment for instability between 1998 and 2007, 34 patients (46 knees, 22 unilateral and 12 bilateral; mean age 19.9 ± 5.4 years) with atraumatic dislocations, positive J-signs and concomitant patella alta underwent tibial tubercle distalization after failed nonoperative treatment and were followed prospectively. Patients with lateral lying patella on Merchant view radiographs had an Elmslie-Trilliat medialization and distalization procedure, whereas patients with normal patellar alignment underwent tubercle distalization without medialization. Mean distalization amount was 12.3 ± 2.9 mm. Mean medialization amount was 6.2 ± 2.1 mm. Patients were evaluated objectively with radiographs, range of motion, and quadriceps muscle strength. Subjective analysis was performed via the International Knee Documentation Committee (IKDC) score.

Results:
Mean clinical follow-up was 5.2 ± 2.8 years. All knees had significantly less patella height after surgery the from the tip of the patella to Blumensaat’s line (from 10.5 ± 5.5 mm to -0.1 ± 8.1 mm) and from the tip of the patella to the tibial plateau (from 31.5 ± 6.3 mm to 24.3 ± 7.8 mm). Knees with abnormal congruence angles and linear displacements (32 knees) also had improvement of these measurements to within normal parameters (from 33.1° ± 21.2° to 1.3° ± 22.5° for the congruence angles and from 8.5 ± 4.9 mm to 0.4 ± 4.9 mm for the linear displacement). Knee range of motion was maintained from 6-0-147 preoperatively to 6-0-148 postoperatively. All but 3 patients had symmetrical knee range of motion postoperatively, two of whom had 5° loss of extension, and one had 10° degrees loss of flexion compared with the other knee. The mean side-to-side quadriceps muscle strength was 94.7 ± 11.7 percent. The mean IKDC subjective score at a mean time of 5.3 ± 3.1 years after surgery was 82.6 ± 16.8 points. Redislocations occurred in 4 of 46 knees (8.7%); two patients reported mild slipping of the patella after surgery.

Conclusions:
In patients with patellar instability due to patella alta, an tibial tubercle distalization is an effective treatment procedure for realigning the patella in the trochlear groove and preventing dislocation.

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No disclosure.
Clinical and Functional Outcomes Following Primary Repair Versus Reconstruction of the Medial Patellofemoral Ligament for Chronic Patellar Instability

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Objectives:
Previous studies have evaluated medial patellofemoral ligament (MPFL) repair or reconstruction, with both surgical techniques showing some benefit.1,2 No previous studies, however, have compared the outcomes between repair versus reconstruction in the setting of chronic patellar instability, which is the purpose of this study. Our hypothesis was that outcomes would be similar for both surgical options.

Methods:
Twelve (F9, M3) patients who underwent MPFL repair and eight (F5, M3) patients who underwent reconstruction at our institution voluntarily returned for clinical objective and subjective evaluations and quadriceps function assessment. The mean age at operation was 19.5 for repair and 19.75 for reconstruction. All patients had a minimum of 2 years follow-up (range 24 – 75 months). Patient subjective outcomes were obtained using the International Knee Documentation Committee (IKDC) and Kujala patellofemoral subjective evaluations, as well as Visual Analog and Tegner Activity scales. Bilateral isometric quadriceps strength and vastus medialis obliquus and vastus lateralis surface EMG was measured during maximal isometric quadriceps contractions at 30° and 60° of flexion.

Results:
Patients undergoing MPFL repair had a postoperative IKDC average score of 75.3 vs. 62.2 for patients undergoing MPFL reconstruction (P > 0.05). The Kujala patellofemoral subjective evaluation was 80.6 for repair vs. 73.4 for reconstruction (P > 0.05). The Tegner Activity Scales were 6 before surgery and 6.4 after surgery for repair vs. 7.9 before surgery and 5.3 after surgery for reconstruction (P > 0.05). The average Visual Analog Scores were 1.2 for repair vs 3.4 for reconstruction (P = 0.002). During knee extensor maximum voluntary isometric contraction at 30° and 60° of knee flexion, repair patients exhibited greater mean EMG amplitude of the vastus medialis (30°: P=0.02, 60°: P=0.04) and vastus lateralis (30°: P=0.02, 60°: P=0.01).

Conclusions:
There were no significant differences found between patients undergoing MPFL repair and MPFL reconstruction for the subjective evaluations, except that patients undergoing repair had less post-operative pain as documented on the Visual Analog Scale. Patients undergoing MPFL repair exhibited significantly more vastus medialis and vastus lateralis EMG activity while performing maximal knee extension contractions than patients undergoing MPFL reconstruction. Based on this data, MPFL repair is at least as effective as reconstruction for chronic patellar instability.

References:

Relevant disclosure declaration for all authors:
No disclosure.
A Prospective Randomized Study Comparing Arthroscopic Single Bundle and Double Bundle Posterior Cruciate Ligament Reconstructions Preserving Remnant Fibers

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Objectives:
We compared clinical and radiographic results between single bundle PCL reconstruction and double bundle PCL reconstruction, both preserving the remnant fibers.

Methods:
We prospectively analyzed 25 cases of single bundle reconstruction preserving remnant fibers using Achilles tendon allograft and 28 cases of double bundle reconstruction preserving remnant fibers using Achilles tendon allograft with a minimum 2 year follow-up.

Results:
There was no difference in range of motion, Tegner activity score, Lysholm score, IKDC subjective knee evaluation form between the two groups at least 2 year follow up. The side to side difference in posterior translation on the posterior stress roentgenogram significantly improved after PCL reconstruction from 12.0mm to 4.5mm in the single bundle group (p<0.001), and from 12.2mm to 3.1mm in the double bundle group (p<0.001). There was no preoperative difference in posterior instability between the groups, but a significant difference was found at the last follow up (p=0.048). On IKDC examination form, in the single bundle group, 24% were found normal; 48%, nearly normal; 24%, abnormal; and 4%, severely abnormal. In the double bundle group, 54% were found normal; 32%, nearly normal; 14%, abnormal at the last follow-up. The double bundle reconstruction group presented better results in the grade distribution (p=0.031).

Conclusions:
The double bundle reconstruction preserving remnant fibers for posterior cruciate ligament ruptures showed better results in posterior stability and IKDC examination form than the single bundle reconstruction preserving remnant fibers did.

References:

Relevant disclosure declaration for all authors:
No disclosure.
Development of a Clinical Prediction Tool to Identify Those at Risk for Development of Patellofemoral Pain

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Objectives:
Prospective measures of increased (>15.4 Nm) knee abduction moment (KAM) during landing identify female athletes at increased risk to develop patellofemoral pain (PFP). Regression analysis has isolated biomechanical laboratory measurements which are able to accurately (sensitivity 92% and specificity 74%) quantify KAM loads during landing. These KAM loads are directly associated with increased risk of patellofemoral pain. The purpose of this study was to identify clinical correlates to laboratory-based measures of increased KAM status for use in a clinic-based PFP injury risk prediction algorithm. The hypothesis was that clinically obtainable correlates, derived from the highly predictive laboratory-based models, would show high accuracy to determine increased KAM status.

Methods:
Female basketball and soccer players (N=744) from a single county public school district were recruited to participate in testing of anthropometrics, maturation, laxity/flexibility, strength and landing biomechanics prior to their competitive season. Pearson correlation and logistic regression was used to examine increased KAM (>15.4 KM) versus normal KAM as surrogate for PFP injury risk.

Results:
Significantly related clinical correlates to laboratory-based measures were identified that combined to predict increased KAM status with 92% sensitivity and 47% specificity. The clinic-based prediction algorithm, including (Odds Ratio: 95% confidence interval) knee valgus motion (1.39:1.27-1.53 cm), center of mass height (1.02: 1.02-1.03 mm) and ratio of hamstrings strength to body composition (2.34:1.35-4.12 %) predicted increased KAM status with C statistic 0.80. Figure 1 presents a predictive, clinician friendly nomogram developed from the analysis described above that can be used to predict high KAM (15.4 Nm KAM) based on center of mass height, knee valgus motion, and ratio of hamstrings strength to body composition.

Figure: 1 PFP Prediction Nomogram

The clinic-based nomogram code generates an equally distributed, segmented line representing standardized measurable units for each clinic-based predictor variable of high KAM status.
Development of a Clinical Prediction Tool to Identify Those at Risk for Development of Patellofemoral Pain

Conclusions:
The defined clinical correlates to laboratory measured knee biomechanics associated with increased risk of PFP yielded a highly sensitive model to predict increased KAM status. Combined use of these correlates in clinic-based screening algorithms that employ measurements derived from standard camcorder and physician scales may be used to identify athletes at increased risk of PFP who may benefit from a targeted exercise intervention to reduce their injury risk.

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References:

Relevant disclosure declaration for all authors:
No disclosure.
Impact of Gender and Sports on the Risk of Full-Thickness Articular Cartilage Lesions in Anterior Cruciate Ligament Injured Knees - A Nationwide Cohort Study from Sweden and Norway of 15783 Patients

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Objectives:
The presence of an articular cartilage lesion in ACL injured knees is considered as a predictor of osteoarthritis. The purpose of the study was to evaluate risk factors for full-thickness articular cartilage lesions in ACL injured knees, in particular the role of gender and the sport causing the initial injury.

Methods:
Primary unilateral ACL reconstructions prospectively registered in the Swedish and the Norwegian National Knee Ligament Registry during 2005-2008 were included (n=15783). Logistic regression analyses were used to evaluate risk factors for cartilage lesions.

Results:
1012 patients (6.4%) had full-thickness cartilage lesions. Males had an increased odds of full-thickness cartilage lesions compared to females (OR=1.22, 95% CI, 1.04-1.42). In males, team handball had an increase in the odds of full-thickness cartilage lesions compared to soccer (OR=2.36, 95% CI, 1.33-4.19). Among females no sports investigated showed significant decrease or increase in the odds of full-thickness cartilage lesions. The odds of a full-thickness cartilage lesion increased by 1.006 (95% CI, 1.005-1.008) for each month elapsed from time of injury until ACL reconstruction in the overall material, while time from injury to surgery did not affect the odds significantly in those ACL reconstructed within one year from injury (OR=0.98, 95% CI, 0.95-1.02). Previous surgery increased the odds of having a full-thickness cartilage lesion (OR=1.40, 95% CI, 1.21-1.63), and the aging of the patient also increased the odds (OR=1.05, 95% CI, 1.05-1.06).

Conclusions:
Male gender is associated with an increased risk of full-thickness articular cartilage lesions in ACL injured knees. Male team handball had an increased risk of full-thickness lesions. No other sports investigated were found to have significant impact on the risk in any of the genders. Furthermore, age, previous surgery and time from injury to surgery exceeding 12 months are risk factors for full-thickness cartilage lesions.

Relevant disclosure declaration for all authors:
No disclosure.
Higher Preoperative Compartment Pressure Values and Younger Age Lead to Improved Clinical Outcomes After Fasciotomy in Patients with Exertional Compartment Syndrome

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Objectives:
The pathophysiology of exertional compartment syndrome (ECS) is poorly understood. While compartment pressures are commonly used to determine treatment (fasciotomy vs. nonoperative), current guidelines are supported by only a few small series. The goals of this study were to compare treatment modalities in ECS and to determine objective criteria that predict good clinical outcomes.

Methods:
From November 1999 to July 2008, 266 patients with clinical symptoms of ESC underwent both pre- and post-exertional lower extremity compartment pressure testing by the senior author. The patients were then offered either non-operative treatment or compartment release. Patients completed a telephone questionnaire describing their pre- and post-operative condition, which included quality and duration of symptoms, analog pain scale, functional and pain improvement since treatment, and satisfaction with treatment. Medical records were reviewed for operative reports, compartment pressure tests, and office visit notes. Statistical Analysis: Group differences among continuous variables were evaluated using independent samples t-tests or ANOVA. Group differences for discrete variables were evaluated using chi-square or Fisher’s Exact Test.

Results:
99 patients (65 female, 34 male) with a mean age of 34.4 (range 16-68) were available for telephone interview at an average 5.37 year follow up (range 1.39 to 11.12). 27 patients were treated non-operatively. 72 patients were treated with either one or two compartment fasciotomy. In the surgical group, 40% were pain-free and 79% reported “significantly improved” or pain-free compared to the nonsurgical group (15% and 35% respectively). In the surgical group, patients with post-exertional compartment pressures of >40mmHg reported less failed surgeries (no improvement or worse than pre-op) at 7.5% compared to patients <40mmHg (15.4%). Operative patients less than 25 years of age were more satisfied with the results (84%) than patients age greater than 25 years (70%).

Conclusions:
To our knowledge, we report the largest series of clinical outcomes for ECS patients and the only series to correlate compartment pressures to clinical outcomes. In patients with symptoms consistent with ECS, operative treatment had improved clinical outcomes compared to nonoperative treatment. Pressures of >40mmHg and age <25 years were factors that were associated with improved subjective function and satisfaction. These results may help guide treatment in this patient population.

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No disclosure.
Sideline Management of Concussions in Adolescent Athletes: Can the Sport Concussion Assessment Tool 2 (SCAT2) be accurately used to determine Return to Play status?

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Objectives:
The SCAT2 is a commonly used sideline assessment tool to manage sports concussions. Historically, a maximum score of 100 has been used as a baseline for all athletes. The purpose of this study is to determine representative baseline SCAT2 scores in adolescent athletes and to examine whether gender differences and prior concussion history affect baseline scores.

Methods:
Male (n=872, age=15.7±1.3 years, grade=10.2±2.9) and female (n=262, age=15.6±1.1 years, grade=10.1±1.0) athletes participating on interscholastic athletic teams. Participants were administered the SCAT2, which is comprised of a 22-item graded symptom scale, 2-item sign score, Glasgow Coma Scale (GCS), Maddocks questions, Standardized Assessment of Concussion (SAC), modified Balance Error Scoring System (BESS), and coordination examination. The SCAT2 total score is calculated by summing each component score, and has a maximum of 100 points. Overall representative values were analyzed using descriptive statistics. Two separate, independent t-tests, with gender and concussion history as the independent variables, were conducted to assess differences in SCAT2 total (p<.05). The dependent variable was the SCAT2 total score. Lower scores on the SCAT2 indicate greater deficits.

Results:
The SCAT2 total score across all subjects was 88.3±6.8 (range=58-100), skewness=-.86±.07, kurtosis=.73±.14. Athletes with a prior history of at least one concussion scored significantly lower compared to their peers without a concussion history (p<.001, 87.0±6.8 vs. 88.7±6.5) on the SCAT2 total score. Females scored significantly higher on the SCAT2 total score compared to males (p=.03, 88.7±6.8 vs. 87.7±6.8).

Conclusions:
These data provide the first insight into representative scores on the SCAT2 in adolescent athletes and demonstrate that males and those with a concussion history scored significantly lower than their female or non-concussed peers, respectively. Variability in baseline SCAT2 scores was due to the symptom score, SAC, and BESS. These values suggest that otherwise healthy adolescent athletes display variability at baseline, and a baseline score of 100 points is not an accurate value in this population. Therefore it is recommended that the SCAT2 test should not be used to determine Return to Play status without individualized baseline SCAT2 values.

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No disclosure.
Midterm Outcomes of Hemiarthroplasty with Biologic Glenoid Resurfacing and Results of Conversion to Total Shoulder Arthroplasty

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Objectives:
Biological resurfacing of the glenoid with lateral meniscus allograft or human acellular dermal tissue matrix for treatment of glenohumeral arthritis in young patients has an unacceptably high failure rate at intermediate-term follow up. The purpose of this study is to compare the clinical outcomes of biological interposition arthroplasty of the glenohumeral joint using either a lateral meniscus allograft (LMA) or a human acellular dermal tissue matrix (HADTM).

Methods:
45 patients with a mean age of 42.2 years were treated with biologic resurfacing of the glenoid were followed for an average of 2.8 years. Among the 41 patients (91.1%) available for follow up evaluation LMA resurfacing was used in 31 cases and HADTM interposition was used in 10 cases.

Results:
The overall clinical failure rate was 51.2% (21 of 41 patients). Failure was defined as actual or recommended conversion to TSA, revision surgery for graft removal, patient reported disabling pain/loss of function and/or post-operative ASES score of < 50. The LMA cohort had a failure rate of 45.2% with a mean time to failure of 3.4 years. Those treated with a HADTM had a failure rate of 70.0% with a mean time to failure of 2.2 years. Nine patients (22%) failed treatment within 2 years of the procedure.

Conclusions:
Biologic resurfacing of the glenoid with LMA or HADTM results in a high rate of clinical failure at intermediate follow-up. Our results suggest that biologic resurfacing of the glenoid may not have a role in the management of glenohumeral arthritis in the young active patient.

Relevant disclosure declaration for all authors:
No disclosure.
Complications Related to Anatomic Reconstruction of the Coracoclavicular Ligaments

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Objectives:
We sought to review the complications related to several new techniques for the anatomic reconstruction of the coracoclavicular (CC) ligaments for the treatment of acromioclavicular (AC) separations.

Methods:
We conducted a retrospective review of the operative treatment of AC separation utilizing anatomic reconstruction of the CC ligaments by reviewing the case logs at a single academic sports medicine center for the last 5 years using appropriate CPT codes. The medical records and postoperative radiographs were assessed for complications.

Results:
27 cases of anatomic reconstruction of the CC ligaments were reviewed. All patients had an autograft or allograft ligament reconstruction utilizing either a coracoid tunnel (10 cases) or a loop around the coracoid base (17 cases). Eight complications (80%) were noted in the coracoid tunnel group including 2 coracoid fractures (20%), 5 patients with some loss of reduction (50%), and 1 patient with an intraoperative failure of the Endobutton (10%). 6 patients developed complications in the coracoid loop group (35%) including 3 clavicle fractures (18% within group, 11% overall), 1 patient with loss of reduction (6%), 1 patient with loss of reduction and an infection (6% within group, 4% overall), and 1 patient with adhesive capsulitis post-operatively (6% within group, 4% overall).

Conclusions:
Newer techniques for the anatomic reconstruction of the CC ligaments may have steep learning curves associated with iatrogenic complications such as coracoid and clavicle fractures. Loss of reduction continues to be associated with the operative treatment of high grade AC separations. Further refinement of surgical technique and experience with the operative treatment of AC separation is warranted.

Relevant disclosure declaration for all authors:
No disclosure.
Revision Rates and Outcomes of SLAP 2 Repairs: A Prospective Analysis of 179 Patients

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Objectives:
To prospectively analyze the clinical outcomes of the arthroscopic treatment of Type 2 SLAP tears in a young, active patient population, and to determine factors associated with failure of treatment.

Methods:
A total of 209 patients with mean age of 31.6 (range, 18 to 45) over a 4-year period with a SLAP tear were prospectively enrolled. Two sports/shoulder trained orthopaedic surgeons performed SLAP 2 repair with between 1 to 2 anchors (mean 1.6 anchors) and vertical suture construct. Patients were excluded if they underwent any additional repairs, including rotator cuff, labrum repair outside of the SLAP region, biceps tenodesis or tenotomy, or distal clavicle procedures. At a mean of 40.4 months (range 26-62 months), a total of 179 patients underwent a comprehensive preoperative and postoperative assessment with WOSI, ASES, SANE, and physical examination of range of motion. In addition, a failure analysis was conducted to determine variables associated with failure.

Results:
Out of the 179 patients, there were a total of 56 patients (31.2%) who were determined to have failed the procedure, and of those, 48 have undergone revision surgery to a biceps tenodesis (in 40), tenotomy (in 4), and debridement (in 4). The mean preoperative scores (WOSI=54%, SANE=50%, ASES=65) improved to postoperative scores (WOSI=82%, SANE=85%, ASES=88). However, in those that had failed, the mean scores were not statistically different from preoperative scores. The mean postoperative range of motion was 150 degrees of flexion, 145 abduction, and 60 external rotation at the side, and was much less in those that had failed the procedure. Advanced age within the cohort (>36) was associated with a statistical increase in failure.

Conclusions:
Repairs of SLAP 2 lesions remain a challenge. This study demonstrated that over 31% of the patients had failed, with a high revision rate. Those over the age of 36 were associated with a higher chance of failure. One should approach the patient with a SLAP tear with caution and choose surgical repair only if indicated. Additional work is necessary to determine optimal diagnosis, indications, and surgical management for those with SLAP tears.

Relevant disclosure declaration for all authors:
No disclosure.
# Clinical Outcomes After Open Subpectoral Biceps Tenodesis in Patients Younger than 35 Years Old

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**Objectives:**
Open subpectoral biceps tenodesis provides a significant improvement in pain relief and shoulder function in patients under the age of 35 who present with symptomatic pathology of the long head of the biceps. The purpose of this study is to report on the clinical outcome of patients younger than 35 years old who have undergone open biceps tenodesis.

**Methods:**
24 consecutive patients were identified as having an open bicep tenodesis prior to age 35 (average 28.8 years). 4 were excluded because their procedure included arthroplasty. 14 of 20 (70%) were available for follow-up evaluation consisting of a physical examination including strength, range of motion, and provocative testing and a survey used to calculate the VAS, SST, ASES, and Constant Scores, which were compared to preoperative values.

**Results:**
Overall patients showed significant improvement in subjective outcome measures. SST scores increased substantially from 5.5 to 10.1 (p < 0.02) while ASES score also showed significant improvement from 56.9 pre-op to 76.8 post-op (p < 0.03). Glenohumeral forward flexion and external rotation in the operative shoulder also improved from 147.6 and 57.5 degrees to 157.3 and 70.0 degrees respectively (both p-values NS). While bicep tenderness was observed in 93% of the patients prior to surgery, none demonstrated bicep tenderness at follow-up.

**Conclusions:**
Bicep tenodesis is a surgical procedure intended to address symptomatic pathology of the long head of the biceps tendon. This is the first significant clinical study of open bicep tenodesis to report results in patients less than 35 years of age. Open subpectoral biceps tenodesis provides a significant improvement in pain relief and shoulder function in patients under the age of 35 who present with symptomatic pathology of the long head of the biceps.

**Relevant disclosure declaration for all authors:**
No disclosure.
ID 20 - 9991

Open Subpectoral Biceps Tenodesis: An Anatomical Study and Evaluation of At-Risk Structures
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Objectives:
Few studies report complications following open subpectoral biceps tenodesis. With increased use of the subpectoral biceps tenodesis technique more complications may become evident. The purpose of this study is to provide the first anatomic description of at-risk structures during subpectoral tenodesis.

Methods:
The standard open subpectoral biceps approach[1] was performed in 17 upper limbs. As originally described, a blunt Chandler was positioned on the medial aspect of the humerus to retract the coracobrachialis and short head of the biceps. The location of the tenodesis was consistently referenced at the medial border of the biceps and inferior aspect of the pectoralis tendon. Important anatomic structures were identified, including the cephalic vein, medial brachial cutaneous nerve of the arm and forearm, intercostal brachial cutaneous nerve, musculocutaneous nerve, axillary nerve, brachial artery and vein, radial nerve, and deep brachial artery.

Results:
Seventeen upper extremity dissections were performed in 9 cadavers. The cephalic vein was 9.2 mm ± 6.1 mm and 13.7 mm ± 5.8 mm lateral to the superior and inferior margins of the incision respectively. The musculocutaneous nerve was 10.1 mm ± 3.2 mm medial to the tenodesis location and 2.94 mm ± 1.4 mm medial to the medially placed retractor. In internal rotation the musculocutaneous nerve was 8.1 mm ± 3.3 mm from the tenodesis site compared to 19.4 mm ± 8.2 mm in external rotation (p< .001). The radial nerve and deep brachial artery were 7.4mm ± 3.0 mm and 5.7 mm ± 2.9 mm deep and medial to the medially placed retractor. The median nerve, brachial artery and brachial vein were not at risk during deep dissection.

Figure 1. At-risk structures in open subpectoral biceps tenodesis.
Conclusions:
This study provides an anatomic assessment of at-risk structures in subpectoral biceps tenodesis. The proximity of the musculocutaneous nerve to the tenodesis site and medial retractor make this a particularly vulnerable structure. External rotation of the arm moves the nerve 11.3 mm away from the tenodesis site and this maneuver should be applied during deep dissection. Although not previously described as a potential complication, the proximity of the leading edge of the medial retractor to the radial nerve and deep brachial artery is important and should be considered when placing this retractor. With increased use of this procedure adverse outcomes related to damage of surrounding neurovascular structures are plausible but may be prevented by an improved understanding of the applied anatomy.

References:

Relevant disclosure declaration for all authors:
No disclosure.
A Prospective Randomized Trial of Acromioplasty in Patients Undergoing Arthroscopic Rotator Cuff Repair: Preliminary Results

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Objectives:
Acromioplasty is commonly performed during arthroscopic rotator cuff repair and may help address extrinsic impingement contributing to pathology seen in rotator cuff disease. In addition, removing an acromial spur may eliminate a pain generator and improve visualization and possibly, improve the technical aspects of rotator cuff repair. Limited data suggests that acromioplasty may not be required in all rotator cuff repairs. The purpose of this study is to report the clinical outcomes and changes in range of motion of patients undergoing an arthroscopic rotator cuff repair with and without acromioplasty.

Methods:
Patients undergoing arthroscopic repair of full thickness rotator cuff tears were randomized into acromioplasty or non-acromioplasty groups. Pre-operatively, validated outcome scores including the Simple Shoulder Test (SST), American Shoulder and Elbow Surgeons score (ASES), Constant score, UCLA score, and SF-12 health assessment were collected along with physical examination including range of motion and dynamometer strength testing. Intra-operative data including tear size, repair configuration, and concomitant procedures were recorded.
Postoperatively, follow-up examination was performed at 6 weeks, 6 months, and 1 year. In addition, pre-operative imaging was reviewed to classify the acromial morphology, acromial angle, and lateral acromial angulation.

Results:
Fifty-seven patients completed surveys pre- and post-operatively at 6 months. Post-op physical exams were conducted on 94% of these patients. Thirty-three patients were randomized to the acromioplasty group and 24 to the non-acromioplasty group.
Thirty-nine patients completed surveys pre- and post-operatively at 1 year. Post-op physical exams were completed on 72% of these patients. Twenty-five patients were randomized to the acromioplasty group and 14 to the non-acromioplasty group (Table 1).
Outcome scores improved significantly (p < 0.05) in both groups from pre- to post-operatively at both time points. There was no statistical difference in clinical outcome when comparing acromioplasty and non-acromioplasty groups at both follow-up time points (Table 2). No differences in outcomes or range of motion were found when examining patient subsets based on acromial morphology (Figure 1a,b,c).
Conclusions:
The results of this study demonstrate that acromioplasty performed concomitantly with rotator cuff repair does not improve clinical outcomes or range of motion at 6 months and 1 year postoperatively.

Relevant disclosure declaration for all authors:
No disclosure.
ID 22 - 9999

Temperature Variations in the Subacromial Space During Use of a Radiofrequency Probe in Shoulder Arthroscopy and Subsequent Risk of Adhesive Capsulitis


Objectives:
Adhesive capsulitis is occasionally seen in the post-operative course of arthroscopic shoulder surgery. Only a few other causes have been identified for this condition. 1 area not studied is the temperature variation inside the subacromial bursa during use of the radiofrequency device. Our hypothesis was there was no difference regarding the use/non-use of the radiofrequency device during arthroscopic shoulder surgery. We examined the temperature changes for various lengths of time while using the radiofrequency probe.

Methods:
This prospective, randomized study recorded temperature variations using a probe in the subacromial space during rotator cuff repairs, subacromial decompressions, and distal clavicle resections. Each procedure was performed by the primary author (n=55, 31 male, 25 female). The same bipolar radiofrequency ablation device was used in each procedure. All temperatures were recorded using an Esophageal stethoscope with temperature sensor. The temperature was recorded every 15 seconds during the procedure and until returning back to the original temperature. After surgery, every patient underwent standard physical therapy protocols for the surgery performed. Range of motion and signs of adhesive capsulitis were assessed postoperatively.

Figure 1

The bipolar radiofrequency ablation device, Crossfire Arthroscopic Resection System (Stryker Endoscopy, San Jose, CA) was used in each procedure. The radiofrequency device was placed inside the subacromial space via the lateral portal and the temperature probe through the anterorsuperolateral portal to ensure proper measurements during rotator cuff repairs, acromioplasties and distal clavicle resections.

Results:
A control group used a burr and shaver. Shoulders treated with radiofrequency were separated into 3 groups: 0-1 min (Group 1), 1-2 min (Group 2), 2-3 min (Group 3). The time and temperature were measured while using radiofrequency. The control group had avg surgical temperature (AST)-20.5?;range-0.7?. Group 1: AST-22.4?;range-4.7?. Group 2: AST-23.9?;range-5.9?. Group 3: AST-26.1?;range-10.1?. The highest single temperature recorded was 35.4?.
Conclusions:
Temperature elevation during arthroscopic surgery had minimal increase while in use. Shoulder arthroscopy is performed with an inflow solution cooler than body temperature. With continual use of the radiofrequency device as in this study, the saline temperature never reached body temperature. Based on the temperature not exceeding body temp, it is unlikely for a cause of adhesive capsulitis/significant collateral tissue damage. Post-operatively, range of motion did not differ between patients undergoing radiofrequency device use versus the control group; thus, suggesting the radiofrequency device and minor temperature elevation is not a cause of post-operative adhesive capsulitis. Future research to assess other potential causes of post-operative adhesive capsulitis is recommended.

References:

Relevant disclosure declaration for all authors:
No disclosure.
Arthroscopic Primary Rotator Cuff Repairs in Patients Under the Age of 45

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Objectives:
While pathology of the rotator cuff is typically related to a degenerative etiology, there is a subset of young patients who experience rotator cuff injury, often related to trauma. Little is known regarding the overall outcomes of young patients with rotator cuff tears, and it may be difficult to obtain reliable results given that younger patients place a higher demand on their repaired cuff than the traditional population. The purpose of this study is to evaluate the mechanism of injury and clinical outcomes following arthroscopic primary rotator cuff repair in patients under the age of 45.

Methods:
A total of 70 consecutive patients were reviewed in a multicenter (two) retrospective study. Fifty three patients (75.7%), with a mean age of 37.5 years (range 16.2 to 44.9 years) were available for follow-up at a mean of 35.8 months (range 13.8 to 59.1 months). Exclusion criteria included revision procedures, repair of partial tears, and follow-up less than 12 months. Follow-up examinations included range of motion testing and clinical outcome measures including Single Assessment Numeric Evaluation (SANE) and American Shoulder and Elbow Society (ASES). Revision surgery or post-operative ASES score less than 50 were considered failure criteria.

Results:
A total of 68.8% (22/32) of the patients had a traumatic etiology, with 31.3% (10/32) related to an athletic event. Concomitant procedures performed at the time of rotator cuff repair included 11 biceps tenodesis, 1 superior labral repair, 5 distal clavicle excisions, and 2 anterior stabilizations. The mean post-operative SANE score was 80.8 (range 10 to 100, SD 20.2), while the post-operative ASES score was 84.5 (range 21.7 to 100, SD 17.1). In the 38 patients available for clinical follow-up exam, forward flexion improved from 158.7 (range 45 to 180, SD 33.2) to 168.4 (range 120 to 180, SD 17.3, p=.014). No significant change in external rotation was seen pre to postoperatively. At the time of follow-up, 0 patients had undergone revision surgery. Two patients (4.0%) were considered failures based on poor clinical outcome.

Conclusions:
The results of this study indicate that arthroscopic primary rotator cuff repair of full thickness tears in patients younger than 45 provides reliable pain relief and restoration of shoulder function in this unique patient population. Longer-term studies are required to determine if similar results are maintained in young rotator cuff patients over time.

Relevant disclosure declaration for all authors:
Comparison of 2 Partial versus Complete Arthroscopic Repair of Massive Rotator Cuff Tears

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Objectives:
Complete repair of massive rotator cuff tears is often limited by tendon retraction and poor tissue quality. Although extensive arthroscopic releases improve tendon mobility, there are occasions when the lateral tendon edge is unable to be completely reapproximated to the footprint. Partial repair, however, can often be accomplished. The purpose of this study is to evaluate the outcomes of a consecutive series of patients undergoing arthroscopic repair of massive rotator cuff tears. Patients with only a partial arthroscopic repair were compared with those where a complete arthroscopic repair was accomplished. Our hypothesis is that partial repair will yield comparable strength, function, and pain relief results when compared to complete repair of massive rotator cuff tears.

Methods:
A computer database search was done in order to identify all consecutive arthroscopic rotator cuff repairs done at our institution over a two year period (January 1, 2008 – January 1, 2010). This search yielded a total of 1,128 patients who underwent arthroscopic rotator cuff repair. A retrospective chart review was performed. Inclusion criteria required that the cuff tear measure 30 cm square or greater. Operative reports were reviewed, and the repair configuration was noted. Patients were categorized as either partial versus complete repair. UCLA shoulder scores were used to measure patient outcomes at an average follow up of 20 months (8 – 31 months). The UCLA shoulder scores between the two groups were then compared for significant difference using an unpaired t test.

Results:
Of those 1,128 cases, 97 (9%) patients were noted intraoperatively to have massive rotator cuff tears measuring 30 cm square or greater. In those patients with massive cuff tears, complete repair was achieved in 52 patients, while only partial repair was possible in 45 patients. Four patients from the complete repair group and 6 patients from the partial repair group had inadequate follow up leaving 87 patients for evaluation. The 48 patients with a complete repair achieved a mean UCLA score of 31.36. The 39 patients with only a partial repair achieved a mean UCLA score of 30.96 (p = 0.7705).

Conclusions:
There are instances when a complete repair of the rotator cuff insertion is not possible due to significant retraction and/or poor tissue quality. In these cases, partial repair of the rotator cuff appears to yield results equivalent to those in which a complete repair was accomplished.

References:

Relevant disclosure declaration for all authors:
No disclosure.
The Effect of Lace-Up Ankle Braces on Lower Extremity Injury Rates in High School Basketball Players

Timothy A. McGuine PhD ATC, University of Wisconsin-Madison, Madison, WI; Alison Brooks MD MPH, University of Wisconsin-Madison, Madison, WI; Scott Hetzel MS, University of Wisconsin-Madison, Madison, WI

Objectives:
To determine whether a lace-up ankle brace reduces the incidence of ankle, knee or other lower extremity injuries sustained by high school basketball players.

Methods:
1460 male and female (age 13 – 18) basketball players from 46 US high schools participated in this prospective randomized controlled study for the 2009-2010 season. Teams were allocated to the intervention and control group using stratified cluster randomization. Subjects in the intervention group wore a McDavid lace-up ankle brace for each practice and game throughout the season. ATC’s at each school recorded ankle brace use as well as all basketball exposures and injuries. Injury rates were estimated per 1000 exposures and compared between the intervention and control group using a log-rank test. Cox Proportional Hazards models were utilized to examine the relationship between injury rate and ankle bracing while controlling for covariates such as previous injury history, sex, BMI, age and level of competition.

Results:
A total of n = 78 acute ankle injuries, n = 13 knee injuries and n = 14 other lower extremity injuries were sustained in the control group compared to n = 26 acute ankle injuries, n = 20 knee injuries and n = 30 other lower extremity injuries in the braced group. The incidence of acute ankle injuries was significantly lower (p < 0.001) in the braced group 0.47 compared to the incidence in the control group 1.41 (Cox hazard ratio 0.31, 95% CI: 0.20, 0.49) and was not affected by sex, BMI, age and level of competition. The incidence of acute ankle injuries was lower in the braced group (p = 0.004) for subjects with a history of previous ankle injury (Cox hazard ratio 0.35 (95% CI: 0.17, 0.71) as well as subjects without a history of previous injury (Cox hazard ratio 0.30 (95% CI: 0.17, 0.53) (p < 0.001). There was no difference (p = 0.208) in the incidence of acute knee injuries, 0.35 in the braced group and 0.19 in control group (Cox hazard ratio 1.62, 95% CI: 0.77, 3.42) or other lower extremity injuries, (p = 0.116), 0.52 in the braced group and 0.32 in control group (1.60 95% CI: 0.89, 2.89).

Conclusions:
The use of a lace-up ankle brace reduced the incidence of acute ankle injuries in male and female high school basketball players regardless of their previous history of an ankle injury. The incidence of knee and all other lower extremity injuries was slightly higher in the braced group but not significantly so.

Relevant disclosure declaration for all authors:
No disclosure.
A Biomechanical Comparison of an Open Versus Arthroscopic Approach for the Treatment of Lateral Ankle Instability

Mark Drakos MD, Long Island Jewish, Great Neck, NY; Steve B. Behrens MD, Warren Alpert Medical School, Brown University, Providence, RI; Dave Paller MS, Warren Alpert Medical School, Brown University, Providence, RI; Eve Hoffman BA, Warren Alpert Medical School, Brown University, Providence, RI; Dave Paller MS, Warren Alpert Medical School, Brown University, Providence, RI; Sarath Koruprolu BE, Warren Alpert Medical School, Brown University, Providence, RI; Christopher W. DiGiovanni MD, Warren Alpert Medical School, Brown University, Providence, RI

Objectives:
The current clinical standard for the surgical treatment of ankle instability remains the modified Brostrom procedure. This study sought to biomechanically compare a minimally invasive arthroscopic technique against the more traditional open modified Brostrom technique.

Methods:
20 matched lower extremity cadaver specimens were obtained. Steinman pins were inserted into the tibia and talus, and 6 sensors were affixed to each of the pins to establish relative planes of movement. Specimens were placed in a Telos ankle stress apparatus in an anterior-posterior position and then in a lateral position, while a 1.7 N-m load was applied to simulate the anterior drawer (AD) and talar tilt (TT) tests, respectively. For each of these tests the ankle was held in 15° PF, neutral, and 15° DF, while the movement of the sensors was measured in 3 planes using the Optotrak Computer Nav System. The difference in translation between the talus and the tibia in the loaded AD test and the angle between the tibia and talus in the loaded TT test were calculated and compared to the unloaded state as a means of determining the differences in both translation and angulation. The ATFL and the CFL were then both sectioned from the fibula to simulate ankle instability. The aforementioned measurements in the loaded and unloaded states were repeated on the specimens following sectioning. The sectioned ligaments were then repaired using 2 corkscrew anchors. 10 of the specimens were repaired using a standard open Brostrom repair, while the matched pairs were repaired using an arthroscopic technique. Measurements using the Optotrak were repeated on the specimens following repair. The results of the calculations of the 4 different states (intact, sectioned, arthroscopic, open) were compared using a paired t-test.

Results:
There was a statistically significant difference between the sectioned state and the other 3 states (p<0.05). There were no statistically significant differences between the intact state and either the open or arthroscopic state (p>0.05). There were also no significant differences between the open and arthroscopic repairs with respect to translation and total combined motion during the TT test (p>0.05). [Fig 1]

Figure: 1

Intact State, Open Repair, and Arthroscopic Reconstruction

Conclusions:
Our findings suggest that there is a similar level of restoration in biomechanical function of the ankle after both the arthroscopic and open lateral ligament repairs. This study suggests that biomechanically effective ankle stabilization may be amenable to a minimally invasive approach.

Acknowledgements:
Arthrex (provided suture anchors and Fiberwire)

References:

Relevant disclosure declaration for all authors: No disclosure.
A Biomechanical Analysis of Brostrom Versus Brostrom-Gould Lateral Ankle Instability Repairs

Steve B. Behrens MD, Warren Alpert Medical School, Brown University, Providence, RI; Mark Drakos MD, Long Island Jewish, Great Neck, NY; Byung J. Lee MD, Warren Alpert Medical School of Brown University, Providence, RI; Dave Paller MS, Warren Alpert Medical School, Brown University, Providence, RI; Eve Hoffman BA, Warren Alpert Medical School, Brown University, Providence, RI; Sarah Koruprolu BE, Warren Alpert Medical School, Brown University, Providence, RI; Christopher W. DiGiovanni MD, Warren Alpert Medical School, Brown University, Providence, RI

Objectives:
Both the traditional Brostrom repair and the modified Brostrom-Gould reconstruction are used to surgically address lateral ankle instability. The purpose of this study was to compare the biomechanical stability of both procedures in a cadaveric model.

Methods:
Ten lower extremity cadaver specimens were obtained. Steinman pins were inserted into the tibia and talus, and six sensors were affixed to each of the pins to establish relative planes of movement. Specimens were placed in a Telos ankle stress apparatus in an anterior-posterior position and then in a lateral position, while a 1.7 N-m load was applied to simulate anterior drawer (AD) and talar tilt (TT) tests, respectively. In both circumstances, the ankle was held in 15° PF, neutral, and 15° DF, while the movement of the sensors was measured using the Optotrak Computer Nav System. Differences in translation between the talus and tibia in the loaded AD test and the angle between the tibia and talus in the loaded TT test were calculated and compared to the unloaded state as a means of determining the differences in both translation and angulation. The ATFL and CFL were then both sectioned from the fibula to simulate ankle instability. Measurements were repeated on the specimens following sectioning. A standard Brostrom open repair was performed. All ankles were then loaded and tested. Next, the extensor retinaculum was oversewn to augment the repair (Gould modification). These specimens were again loaded and retested. The results of the calculations of the Brostrom repair versus the Gould modification were compared using a paired t-test.

Results:
There were no statistical differences between the Brostrom procedure, the Brostrom-Gould modification, and the intact state (p > 0.05). There were statistical differences between the sectioned state and both of the repair states (p < 0.05). There were no statistical differences between the traditional Brostrom repair and the modified Brostrom-Gould procedure (p > 0.05). [Fig 1]

<table>
<thead>
<tr>
<th>Anterior Drawer</th>
<th>Anterior/Posterior Translation</th>
<th>Translation Magnitude</th>
<th>Talar Tilt</th>
<th>Inversion/Rotation</th>
<th>Rotation RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantarflexion</td>
<td>-5.17 ± 2.10 mm</td>
<td>5.59 ± 1.75 mm</td>
<td>Intact</td>
<td>10.18 ± 5.91°</td>
<td>18.59 ± 9.21°</td>
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<td>Cut</td>
<td>-9.07 ± 1.95 mm</td>
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<td>Cut</td>
<td>16.96 ± 6.23°</td>
<td>22.59 ± 6.72°</td>
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<tr>
<td>Brostrom Repaired</td>
<td>-5.11 ± 2.78 mm</td>
<td>6.12 ± 2.94 mm</td>
<td>Brostrom Repaired</td>
<td>5.77 ± 2.46°</td>
<td>12.88 ± 5.88°</td>
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<tr>
<td>Gould Repaired</td>
<td>-4.70 ± 2.73 mm</td>
<td>5.34 ± 2.21 mm</td>
<td>Gould Repaired</td>
<td>7.20 ± 5.12°</td>
<td>7.40 ± 4.84°</td>
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Neutral

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<th>Inversion/Rotation</th>
<th>Rotation RMS</th>
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<tr>
<td>Intact</td>
<td>-4.12 ± 2.32 mm</td>
<td>3.92 ± 2.17 mm</td>
<td>Intact</td>
<td>10.58 ± 6.97°</td>
<td>20.59 ± 10.71°</td>
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<tr>
<td>Cut</td>
<td>-5.44 ± 2.42 mm</td>
<td>12.44 ± 4.30 mm</td>
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<td>22.15 ± 6.48°</td>
<td>32.11 ± 7.72°</td>
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<td>Brostrom Repaired</td>
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<td>6.05 ± 2.25 mm</td>
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<td>6.57 ± 2.94°</td>
<td>7.20 ± 5.91°</td>
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<tr>
<td>Gould Repaired</td>
<td>-2.88 ± 2.92 mm</td>
<td>5.82 ± 1.60 mm</td>
<td>Gould Repaired</td>
<td>7.00 ± 5.90°</td>
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Dorsiflexion

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<th>Talar Tilt</th>
<th>Inversion/Rotation</th>
<th>Rotation RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact</td>
<td>-1.62 ± 1.85 mm</td>
<td>4.03 ± 1.25 mm</td>
<td>Intact</td>
<td>6.88 ± 3.67°</td>
<td>10.32 ± 4.90°</td>
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<td>Cut</td>
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<td>5.61 ± 4.04 mm</td>
<td>Brostrom Repaired</td>
<td>7.29 ± 2.87°</td>
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<tr>
<td>Gould Repaired</td>
<td>-3.44 ± 2.79 mm</td>
<td>5.69 ± 1.85 mm</td>
<td>Gould Repaired</td>
<td>6.96 ± 4.34°</td>
<td>6.91 ± 6.97°</td>
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Conclusions:
Our findings suggest that there is no statistical difference in ankle stability conferred by modifying the traditional Brostrom repair with the Gould reconstruction. These data question the ability of the retinaculum to provide any additional biomechanical support in preventing ankle instability. Our study suggests that surgeons should not assume that augmenting primary lateral ankle ligament repairs with the extensor retinaculum will prevent instability in patients who have marginal tissues.
Acknowledgements:
Arthrex (provided suture anchors and Fiberwire)

References:

Relevant disclosure declaration for all authors:
No disclosure.
Objectives:
Technical advances in the ability to address both soft tissue and osseous pathology have introduced a new set of complications associated with hip arthroscopy. While heterotopic ossification (HO) is well-documented complication after major reconstructive hip surgery, the incidence of HO after arthroscopic procedures for FAI remains undefined.

Methods:
From July 2008 to July 2010, 698 hip arthroscopies were performed by the senior author to treat symptomatic FAI. Radiographic images, including an AP and elongated femoral neck view of the hip, were obtained at 6 weeks to evaluate for a stress fracture and/or HO. All incidences of HO were further monitored by additional radiographic imaging at 3 months, 6 months, and 1 year postoperatively. HO was classified by consensus using the Brooker system. Patients with persistent pain or limited range of motion had computed tomography (CT) scans to visualize the growth and location of ectopic bone.

Results:
33 of 698 patients (4.7%) were identified with postoperative HO after FAI surgery. There were 22 males and 11 females with mean age of 31.4 years (range 15-57 years). 22 patients underwent combined femoral and acetabular osteoplasty, 7 had isolated femoral osteoplasty, and 2 had isolated rim procedures. 20 patients (60.6%) demonstrated grade I HO, 6 patients (18.2%) grade II HO, 6 patients (18.2%) grade III HO, and 1 patient (3.0%) grade IV HO (Figure 1). Seventeen patients (51.5%) had HO located anterior to the hip joint and 16 patients (48.5%) had HO located lateral to the hip joint. Incidence of HO was 9.8% among 312 cases not treated with Indocin prophylaxis compared to 1.3% in the 386 treated cases. Among the 33 patients who developed HO postoperatively, 7 symptomatic patients underwent excision of HO. All of these patients were not treated with Indocin, and the average time between the primary and secondary surgery was 10.5 months (range 5.2-15.6 months).

Conclusions:
Symptomatic HO following hip arthroscopy for treating FAI is an uncommon but potentially serious complication. In this large clinical series, the incidence of HO was 4.7%. Iatrogenic trauma to the abductor or hip flexor musculature and failure to use Indocin in the immediate postoperative period increased the incidence of HO after arthroscopy FAI surgery. The rate of HO may be reduced to 1.3% with use of postoperative Indocin, evacuation of bony debris, and minimization of portal trauma to peri-articular musculature.
Relevant disclosure declaration for all authors:
No disclosure.
The Effect of Femoroacetabular Impingement on Pubic Symphysis Motion

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Objectives:
Femoroacetabular impingement (FAI) has been shown to be correlated with athletic pubalgia. The goal of this study was to investigate the effects of the FAI on the 3-D movements at the pubic symphysis.

Methods:
12 fresh-frozen human cadaveric hips were tested. Cam-type FAI was simulated by implanting a small (5mm height) or large (10mm) hemisphere at the femoral head-neck junction. The femoral head-neck offset was normalized by planeing the area before placing the cam. Each hip was tested in three stages: intact, small, and large cam lesions. The hips were internally rotated at ninety degrees of flexion and neutral adduction until the load cell reached its maximum. A 6-axis load cell was mounted on the distal femur, and marker triads from an Optotrak motion tracking system were mounted onto each side of the symphysis pubis to track 3-D joint movement. Symphysis motion due to the cam groups at a common torque level (6Nm) was normalized with respect to the intact.

Results:
Symphysis motion occurred primarily in the transverse plane, and in the direction of opening the joint anteriorly. At 6Nm torque, the mean primary rotation ranged from 0.50±0.28 degrees for the intact to 0.73±0.48 and 0.64±0.34 degrees respectively for the small and large cams. The secondary rotation was in the coronal plane, in the direction of opening the joint inferiorly. There was no difference between groups for the secondary rotation 0.31±0.17, 0.38±0.18, and 0.30±0.20 degrees for the intact, small and large cams (Fig 1). The mean normalized percentage increases with cam impingement over the intact were 54% (small cam, p<0.01) in the transverse plane rotation, and 27% (small cam, p<0.03) in the total symphysis rotation (Fig 2). Symphysis motion increased linearly with hip internal rotation. The mean rates of increase were 0.32±0.1, 0.55±0.3, and 0.33±0.1 degree per 10 degrees of hip internal rotation for intact, small and large cams. The small but not the large cam showed a higher rate of increase over the intact (p<0.05).

Conclusions:
Findings showed that cam impingement had a significant impact on the movement of the symphysis pubis, especially in...
the transverse plane. The magnitudes of the rotation under 6Nm torque of hip internal rotation represented 27-54% increases from the intact. Results also showed that cam size did not cause higher increases in the movement. Symphysis motion also increased with increasing internal rotation simulating the effect of relative retroversion of the proximal femur.

**Relevant disclosure declaration for all authors:**
No disclosure.
ID 30-10181

Arthroscopic Debridement versus Refixation of the Acetabular Labrum Associated with Femoroacetabular Impingement: Minimum 2 Year Follow-up

Christopher M. Larson MD, Minnesota Orthopedic Sports Medicine Institute, Edina, MN; M. Russell Giveans PhD, Fairview/MOSMI, Eden Prairie, MN

Objectives:
The purpose of this study was to update a prior report comparing outcomes of arthroscopic labral debridement to labral refixation.

Methods:
We previously reported outcomes for labral debridement compared to labral repair at minimum 12 months follow-up. We reviewed patients who underwent labral debridement during a period prior to the development of labral repair techniques. Patients with labral tears felt to be repairable with our current arthroscopic technique were compared to patients who underwent labral refixation. To better match the two groups, only patients with labral pathology due to pincer or combined-type femoroacetabular impingement (FAI) were included. In the first 39 hips, the labrum was debrided (Group 1); in the next 40 hips, the labrum was refixed (Group 2). Outcomes were measured with modified Harris Hip Score (HHS), Short Form 12 (SF-12), and a visual analog pain scale (VAS) preoperatively and postoperatively. Preoperative and postoperative radiographs were obtained to evaluate bony resection and osteoarthritis.

Results:
The mean age was 33 years in Group 1 and 28 years in Group 2 with a mean follow up of 34 months (range, 24-60 months). Preoperative mean subjective outcomes scores were not significantly different between groups. At a mean of 34 months follow-up, subjective outcomes were significantly improved (p<0.01) for both groups compared to preoperative scores. Harris Hip scores were significantly better for the refixation group (93.5) compared to the debridement group (84.4) at most recent follow-up (p<0.01). At a mean of 34 months follow-up, good-to-excellent results were noted in 66.7% of the debridement group compared to 90.0% of the refixation group (p=0.014).

Conclusions:
Arthroscopic management of labral pathology and its associated pincer impingement results in significant improvement. With further follow-up (mean 34 months), the labral refixation group continued to demonstrate better HHS outcomes, as well as a greater percentage of good-to-excellent results when compared with the labral debridement group.

Relevant disclosure declaration for all authors:
No disclosure.
Sustained Superior Therapeutic Response after Autologous Cartilage Tissue Implant (ACTI) in Comparison to Microfracture (MF). A Prospective Randomized Trial at Two Years.

Dennis C. Crawford MD, PhD, Oregon Health & Science University, Portland, OR; Thomas M. DeBerardino MD, University of Connecticut Health Center, Farmington, CT; Riley J. Williams III MD, Hospital for Special Surgery, New York, NY

Objectives:
Report clinical outcomes of a novel ACTI in comparison to MF technique for treatment of grade III ICRS distal femoral cartilage injury.

Methods:
A multi-site FDA phase II clinical trial comparing safety and efficacy of ACTI v. MF as primary treatment of chondral injury is reported. Thirty patients were randomized (2:1;ACTI:MF) at arthroscopic confirmation of ICRS Grade III femoral condyle lesion(s). MF or hyaline biopsy was performed at the randomization procedure. ACTI, produced by seeding a collagen I matrix with chondrocytes and bioreactor treatment, was implanted via arthrotomy and sutureless fixation at approximately 6 weeks post-biopsy. MF rehabilitation (Toe touch WB, CPM for 6 weeks) was standard for each group. Evaluations at 3, 6, 12 and 24 months included KOOS, IKDC, SF-36 and VAS pain. Responder analysis was applied using a dual threshold criteria based on previously reported MPCI (minimal perceptible clinical improvement) thresholds for both the KOOS pain and IKDC outcomes measures.

Results:
A minimum of 2 year data is reported for 28 of 30 enrolled patients (19ACTI:9MF). Mean age (40±9yrs), BMI (28±4), injury acuity (3±5yrs) and lesion size (MF252±135mm2 v. ACTI287±136 mm2) were comparable between arms. For both ACTI and MF, SF-36 Physical and IKDC improved from baseline (p<0.025) at 1 and 2 years. Improvement for ACTI v. baseline was significant, p<0.025 for all additional measures: KOOS pain, KOOS symptoms, KOOS ADL, KOOS QOL, SF-36 Role and VAS pain at both 1 and 2 years. Using a paired t-test, ACTI had significantly greater change from baseline than MF in IKDC (p<0.05) and KOOS pain (p<0.05) at both one and two years. ANCOVA analysis of the two groups at one year, indicated KOOS pain score change from baseline between ACTI and MF was significant (P=0.016), with a difference in adjusted means (ACTI-MF) of 12.06 with a 95% CI (2.388, 21.74). The difference in IKDC changes from baseline between ACTI and MF was significant, p=0.028, with a difference in adjusted means. Similarly, more patients (P=0.0125, Fischer’s exact test) in the ACTI arm were therapeutic responders at 6 (43% v. 25%), 12 (76% v. 22%) and 24 months (81% v. 44%).

Conclusions:
ACTI significantly improved knee pain, symptoms and function in comparison to baseline. In pain and function scores, ACTI was associated with significantly greater improvement compared to MF. This preliminary prospective randomized trial reports ACTI treatment is more effective for femoral chondral injury treatment in comparison to MF.

Relevant disclosure declaration for all authors:
No disclosure.
Articular Chondrocyte-based Tissue Engineering for Meniscal Repair: A Swine Study

Jeong Joon Yoo MD, Seoul National University College of Medicine, Seoul, Korea, Republic Of; David Alberto Bichara MD, Massachusetts General Hospital, Harvard Medical School, Boston, MA; Xing Zhao MD, Massachusetts General Hospital, Boston, MA; Mark Randolph MAS, Massachusetts General Hospital, Harvard Medical School, Boston, MA; Thomas J. Gill IV MD, Massachusetts General Hospital, Boston, MA

Objectives:
Meniscal lesions occurring in the avascular medial zone lack the innate regenerative capacity to heal. Although partial meniscectomy can treat symptomatic tears, preservation of the meniscal structures is crucial for the protection of joint surfaces. Our group has previously demonstrated the potential of a cell-based meniscal repair approach seeding chondrocytes onto a flexible PLGA mesh scaffold and implanting it into a swine model (1). However, two chondrocyte types-auricular and articular-were combined in the allogenic and autologous groups, so the results of articular chondrocytes were not clearly demonstrated. In this study, we hypothesized that a lesion in the avascular region of the meniscus can be repaired using both autologous and allogenic articular chondrocytes seeded onto a degradable flexible PLGA scaffold.

Methods:
Sixteen skeletally mature swine were used in this study. After cell harvest from a right knee and seeding onto PLGA scaffold in dynamic oscillating conditions, the articular chondrocyte-seeded implant was sutured into a bucket-handle lesion surgically created in medial menisci of left knee. Autologous cells were implanted into 7 lesions, while allogenic cells in 9. Historical controls (unseeded implant n=3, sutured menisci n=4, no treatment n=4) were used to compare the results. Menisci were harvested after 12 weeks, observed histologically for interfacial healing, and evaluated statistically.

Results:
Areas of healing were demonstrated in 87.5% (14/16) of menisci. None of the control samples demonstrated healing. Histological analysis revealed fibrous healing tissue in 85.7% (6/7) in the autologous group versus 88.9% (8/9) in the allogenic group. Only 1 meniscus in the allogenic group demonstrated healing in its entirety. Two samples, one from each group, did not heal. No statistically significant differences in healing were observed between the autologous and allogenic chondrocyte-based implants.

Conclusions:
Both the autologous and allogenic articular chondrocyte-seeded flexible PLGA scaffolds induced healing of meniscal medial lesion in swine knee joint. This study demonstrates a tissue engineered approach using both autologous and allogenic articular chondrocytes can be a potential option for meniscal repair.

Acknowledgements:
This study was supported by a grant from the Musculoskeletal Transplant Foundation.

References:

Relevant disclosure declaration for all authors:
No disclosure.
Platelet-Rich Plasma as an Enhancement to Cellular Metabolic Behavior in Tendons

John G. Lane MD, University of California San Diego, La Jolla, CA; Robert M. Healey BS, University of California San Diego, La Jolla, CA; Lisa M. Tibor MD, University of California San Diego, La Jolla, CA; David Amiel PhD, University of California San Diego, La Jolla, CA

Objectives:
Clinically, platelet rich plasma (PRP) has shown a stimulatory effect upon lateral epicondylitis healing, however little objective evidence substantiates its benefit. Our purpose was to assess changes in an intact rabbit patellar tendon.

Methods:
Eighteen aged New Zealand White rabbits, at least 4 yrs of age, were used. Aged animal tendons were chosen as they show similar properties to human tendinosis, i.e. collagen disorganization, hypocellularity and low vascular supply. 1-2 Blood was harvested from the rabbit ear pre-surgery and PRP obtained using a centrifugation technique (2,000 rpm for 15 min). In the experimental group (n=10) an incision was made over the patellar tendon and PRP injected under direct vision. A control group of animals (n=8) was studied, injecting the same volume of saline. The patellar tendons were studied at 7 and 28 days post-injection by gross assessment, histology, biochemistry and molecular characterization, using RT-PCR on growth factors FGF, IGF, VEGF and PDGF.

Results:
Platelet concentration following centrifugation was approximately 1.7 times that of whole blood. Grossly, no inflammatory response from injection was observed. Histologically, hematoxylin and eosin (H&E) staining showed hypercellularity in the PRP group at 7 days, but the effect was not as marked at 28 days (Fig. 1). Polarized microscopy showed an increase in crimping density of collagen fibers at 7 days compared with saline injections, demonstrating an upregulation in collagen extracellular matrix (ECM). Cellular migration was stimulated with more organized collagen bundle distribution. This trend was also not as pronounced at 28 days. Biochemically, cellular proliferation as measured by tritiated thymidine was significantly increased (p=0.02) at 7 days in the PRP group (57 ± 12 counts per minute/mg dry tissue) as compared with the saline group (37 ± 4 cpm/mg). This observation was not as significant at 28 days (41 ± 12 cpm/mg for PRP and 29 ± 9 cpm/mg for control). Growth factor characterizations were not seen to be upregulated statistically at 7 and 28 days post PRP injections when compared with saline injections.

Fig. 1. Histological sections illustrating crimping patterns. A) 7 day saline; B) 7 day PRP; C) 28 day saline, and D) 28 day PRP injection. Areas of hypercellularity indicated with an asterisk (*).
Conclusions:
Our study showed an effect of PRP injection in aged rabbit patellar tendon by increased collagen remodeling, hypercellularity and cellular migration. We have also seen a trend of upregulation of FGF (p<0.15) at 28 days when compared with saline injections, but no statistical differences were shown in all growth factors cited above.

Acknowledgements:
Work supported by the Musculoskeletal and Joint Research Foundation, San Diego CA

References:

Relevant disclosure declaration for all authors:
No disclosure.
A Double-Blind Randomized Controlled Trial Comparing the Effects of Subacromial Injection with Corticosteroid versus NSAID in Patients with Shoulder Impingement Syndrome

Kyong Su Min MD, Madigan Healthcare System, Tacoma, WA; Paul Ryan MD, Madigan Healthcare System, Tacoma, WA; Bryant Gene Marchant MD, Madigan Army Medical Center, Tacoma, WA; Chris Wilson MD, Hand Surgery Associates, Sacramento, CA; Edward Arrington MD, Madigan Healthcare System, Tacoma, WA

Objectives:
Subacromial impingement syndrome is commonly treated with corticosteroid injections; however, corticosteroids have been associated with tendon rupture, subcutaneous atrophy and articular cartilage changes. There has been evidence to support that NSAID injections are effective in treating impingement. This study hypothesizes that an injection of ketorolac is as effective as triamcinolone in treating subacromial impingement syndrome.

Methods:
Forty-eight patients clinically diagnosed with isolated external shoulder impingement syndrome who met the inclusion and exclusion criteria were included in this double-blinded randomized controlled clinical trial. Each patient was randomized into the Steroid injection group or NSAID injection group. The Steroid syringe contained 6 cc of 1% lidocaine with epinephrine and 40 mg triamcinolone; and the NSAID syringe contained 6 cc of 1% lidocaine with epinephrine and 60 mg ketorolac. After a single injection, the patients were evaluated and instructed to follow-up in four weeks.

Results:
Both treatment arms resulted in increased range of motion and decreased pain. The mean improvement in the UCLA Shoulder Assessment Score at four weeks was 7.15 for the NSAID group and 2.13 for the Steroid group (p-value: 0.03). Patients in the NSAID group showed an increase in forward flexion strength (NSAID: 0.26, Steroid: -0.07; p-value: 0.04) and patient satisfaction (NSAID: 2.94, Steroid: p-value: 0.03). All other outcome measures were not statistically significant.

Conclusions:
In this study, a single injection of 60 mg of ketorolac is more effective than a single injection of 40 mg triamcinolone in short term the treatment of subacromial impingement. Arguably, the relief provided by the subacromial injection of both ketorolac and triamcinolone is a function of their local anti-inflammatory effect. There is no evidence that ketorolac reverses the pathophysiology of subacromial impingement; however, by decreasing pain, the patient is able to strengthen the rotator cuff and increase the subacromial space. The authors of this study believe that subacromial ketorolac is a viable alternative to triamcinolone in the treatment of subacromial impingement syndrome. While both corticosteroids and ketorolac are effective in the treatment of isolated subacromial impingement, ketorolac appears to have a better local anti-inflammatory effect and does not expose the patient to the potential side-effects of corticosteroids.

References:

Relevant disclosure declaration for all authors:
No disclosure.
A Prospective Randomized Study Comparing Intraarticular Versus Subtendinous Corticosteroid Injection for the Treatment of Lateral Epicondylitis

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Objectives:
The purpose of this prospective randomized study was to compare the efficacy of extraarticular (subtendinous) and intraarticular (soft spot) corticosteroid injection for the treatment of tennis elbow in patients refractory to conservative management.

Methods:
Eighteen patients met the inclusion criteria (pain of more than three months duration, clinical findings of lateral epicondylitis, and failed treatment with physical therapy, rest or NSAIDs.) Eight patients were randomized to the intraarticular (IA) injection group and 10 patients in the extraarticular (EA) group. Injections were administered by the senior author (TAB) and consisted of a mixture of 1cc each of 1% lidocaine, 0.25% marcaine, and 40mg/ml kenalog. Patients were assessed by VAS pain scale, SF-36, DASH and Euroqol scores prior to injection, at 2 weeks, 6 weeks, 3 months, and one year. The early results of this ongoing prospective study are reported. Statistical differences were determined using ANOVA.

Results:
VAS scores both at rest and with activity decreased significantly at 2 weeks post injection in both groups, with a more dramatic improvement seen in the IA injection group. (Figures 1 and 2) By 3 months, there was less improvement in VAS scores, particularly in the IA group. However, VAS scores for both groups were still significantly better than pre-treatment values. With the numbers available, there were no significant differences in VAS scores between the two groups (IA vs EA) at 3 months post-injection. Improvements in Euroqol and DASH scores were also seen in both groups. DASH (15.07 IA v. 20.95 EA) and Euroqol (0.80 IA v. 0.72 EA) scores were slightly better at 3 months in the IA group, however these results were not statistically significant.

Conclusions:
In this prospective randomized study assessing corticosteroid injection for the treatment of lateral epicondylitis, early results demonstrate significant improvements in pain and function in both IA and EA treatment groups. There was a trend toward superior results in the IA group at two weeks post injection, however these results were not maintained at later time points. While further assessment is required, these data suggest that both intraarticular and extraarticular corticosteroid injections are effective early treatments for lateral epicondylitis. Intraarticular injection may offer an effective alternative to the traditional extraarticular subtendinous injection.
References:

Relevant disclosure declaration for all authors:
No Disclosure
Diagnostic Accuracy of Intra-articular Anesthetic Hip Injection in Hip Arthroscopy Patients

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Objectives:
The objective of the study is to determine if there is any association between diagnostic hip injection outcome and pathology seen at hip arthroscopy.

Methods:
We retrospectively reviewed the records for 52 consecutive primary elective hip arthroscopy patients with a documented preoperative, fluoroscopically-assisted anesthetic hip injection. A Fisher Exact Chi Square analysis was conducted to correlate the response to injection with the type of pathology found during hip arthroscopy.

Results:
There were 27 males and 25 females, (mean age 33.8 +/- 8.7 years). Only thirty-one patients (59.6%) with intra-articular pathology. There were 21 false negatives (40.4%) and one false positive (normal hip). Pathology found during arthroscopy included chondromalacia (39 patients), labral tears (38 patients), cam or pincer deformities (21 patients), and ligamentum teres tears (2 patients). A significantly higher proportion of females with pathology had pain relief from injection than males (80.0% vs. 40.7%). Relief from injection was reported in 56% of patients with chondromalacia, 61% of patients with a labral tear, 58% of patients with both chondromalacia and a labral tear, and 47% of patients with evidence of cam or pincer deformity consistent with the diagnosis of femoroacetabular impingement (FAI). Division of the patients into clinical subgroups (only labral tears, only chondromalacia, labral tears and chondromalacia, and FAI inclusive of other pathology) failed to demonstrate a significant association with response to injection. While the presence of FAI showed a trend towards negative response to injection, no significant association could be established.

Conclusions:
In our retrospective analysis, the accuracy of preoperative hip injections (59.6%) is significantly lower than previous reports, suggesting that anesthetic hip injections may not be a sensitive test for detecting all intra-articular pathology in hip arthroscopy patients. Furthermore, no previous reports have correlated the response to injection to the type of pathology seen at arthroscopy. From our review, the response to injection is independent of the type of pathology present. Interestingly, female gender may be more likely to report a positive response to intra-articular injection. Our findings suggest that the preoperative hip injection may not be as reliable of a preoperative screening test as previously reported.

Relevant disclosure declaration for all authors:
No Disclosure.
Adverse Effects of Femoral Nerve Block Analgesia after Anterior Cruciate Ligament Reconstruction

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Objectives:
The efficacy of continuous femoral nerve block (FNB) analgesia after anterior cruciate ligament reconstruction (ACLR) has been documented, but the side effects and complications have not been published. The purpose of this study was to evaluate the adverse effects and complications associated with continuous FNB analgesia following ACLR.

Methods:
Two hundred and thirty-three patients undergoing primary ACLR were recruited. A double-blinded randomized controlled trial was performed from 2001 to 2005. After standardized spinal anesthesia and perioperative multimodal analgesia, patients received a femoral nerve catheter and were randomized to one of three treatment groups with a 30 mL bolus followed by a 270 mL infusion at 5 mL/hr: placebo group (A) - saline bolus followed by saline infusion; bolus only group (B) - 0.25% levobupivacaine bolus followed by saline infusion; and continuous block group (C) - 0.25% levobupivacaine bolus followed by 0.25% levobupivacaine infusion. Patients were contacted after a minimum of five years to assess for neurological symptoms (numbness, tingling, burning, paresthesias), weakness, and instability.

Results:
One hundred and forty-five patients (62%) were available after a mean follow-up of 6.89 years (range 5.33-8.92). Group A had 50 subjects, group B had 52 subjects, and group C had 43 subjects. Sixty-four patients (44%) reported neurological symptoms with no statistically significant differences between the three groups (p = 0.741). Thirty-three patients (23%) complained of residual weakness, with no significant differences between the three groups (p = 0.075). Instability was present in 44% of all subjects, with no significant difference between the three cohorts (p = 0.159).
Conclusions:
Continuous FNB analgesia is a safe and effective method to control pain in patients undergoing ACLR. Although neurological symptoms were present in 44% of patients, there was no significant difference between those receiving FNB analgesia and controls. Furthermore, there was no significant difference in the prevalence of weakness or instability between the three groups. Prior concerns of adverse affects with the use of continuous FNB analgesia do not appear to be warranted.

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References:

Relevant disclosure declaration for all authors:
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ID 38 - 10192

Prevalence of Asymptomatic Findings in Collegiate Basketball Players Using 3T MRI and Change Over The Course of One Season

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Objectives:
Limited data exists regarding the prevalence of asymptomatic findings of the MRI of knees in collegiate and professional basketball players during the pre-season. The goal of this study is to determine the prevalence of findings using state of the art 3T MRI in the asymptomatic knees of male and female collegiate basketball players before and after a season of play.

Methods:
After IRB approval, 24 previously asymptomatic knees of 24 collegiate Division I basketball players (age 18-22; 12 male, 12 female) were imaged using a GE Signa Excite 3.0T MRI scanner (GE Healthcare, Milwaukee, WI). Athletes were imaged prior to and within 1 month following the season. Three players (2 men, 1 woman) did not undergo scanning after the season. An experienced fellowship trained musculoskeletal radiologist and experienced sports medicine fellowship trained orthopaedic surgeon evaluated the 2D-FSE images for pathological changes.

Results:
Pathologies were frequently seen in the patellar region, with signal changes or defects in patellar articular cartilage seen in 10 and 13 subjects pre- and post-season and patellar bone marrow edema in 10 and 16 subjects pre- and postseason. Seven men and 7 women had changes consistent with mild patellar tendinopathy, 1 man and 2 women with moderate changes and 3 men with severe changes of patellar tendinopathy. Post season, 5 men had moderate and 5 men had mild patellar tendinopathy, while 6 women had mild and 3 women had moderate patellar tendinopathy. Seven men and 6 women had mild changes within the quadriceps tendon and 3 men and 2 women had moderate changes pre-season, while 9 men had mild post season changes consistent with quadriceps tendinopathy and only 1 with moderate tendinopathy. Seven women has mild post season quadriceps tendinopathy, while 2 had moderate quad tendinopathy. Nine players (6 women) had intra-mensical change while there was 1 male and 1 female with evidence of old meniscal capsular injury.

Conclusions:
Caution should be taken in interpretation of state-of-the-art imaging techniques in young asymptomatic athletes, as a high prevalence of abnormal findings that do not require intervention may be identified. It appears that high intensity basketball may have potentially damaging effects on patellofemoral articular cartilage. The more severe patellar tendinopathy changes decreased over the season, though similar numbers of players had changes in their patellar tendon and quadriceps tendon pre season and post season

References:
1) Major NM, Helms CA. AJR 179:641-4, 2002

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No disclosure.
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Effects of Meniscus Injury on the Development of Knee Osteoarthritis With Data From the Osteoarthritis Initiative

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Objectives:
Knee Osteoarthritis (OA) is a leading cause of chronic limitation and disability [1]. Many have speculated that meniscus injury may play a key role in the development of knee OA; prior meniscectomy has already been identified as a risk factor [2]. However, the relationship between an untreated meniscus injury and OA is still unknown. We aimed to examine baseline rates of meniscus injuries in individuals who would and would not go on to develop radiographic knee OA over a 2 year follow-up. We also investigated how type, size, and location of meniscus injury affected the development of OA.

Methods:
We used the Knee Osteoarthritis Initiative (OAI), a longitudinal, multi-center database that was developed to study parameters of knee health in individuals at risk for knee OA. We examined baseline MRI images of the contralateral (healthy) knee of individuals who had OA in one knee. We identified 32 individuals who developed radiographic knee OA in their healthy knee within two years (incident OA group), and selected 64 age, sex, and BMI matched individuals who did not develop OA (control group). Radiographic knee OA was defined as having a Kellgren-Lawrence score of 2 or more. All 96 baseline MRIs were read by a radiologist who was blinded to the groupings. They were graded for presence of a meniscus tear or degenerative signal, meniscal extrusion, location of meniscus injury, and size of injury. Conditional logistic regression was performed to identify significant predictors of incident OA.

Results:
Prevalence of medial meniscus tears were similar between groups (47% OA vs. 40% controls). However, when medial meniscus injuries (tear or myxoid degeneration) were examined, there was a trend towards significance (85% OA vs. 68% controls, p=.065). Medial meniscus extrusion (OR=3.03, 95% CI:1.4-6.5), complex tears (OR=5.0, 95% CI:1.0-25), and tears involving more than 1/3 of the meniscus radially (OR=5.92, 95% CI:1.7-7.5) occurred more frequently in the OA group. There were no significant differences in lateral meniscus pathology between groups.

Conclusions:
We found a relationship between extrusion, type, and size of medial meniscus tears and the development of knee OA. While the prevalence of medial meniscus injuries tended to be greater in individuals who would eventually develop OA, certain parameters of the injury seem to be better predictors of OA. Specifically, knees with meniscus tears with greater radial involvement and extrusion are at greater risk for development of radiographic OA.

Acknowledgements:
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References:
1. The Osteoarthritis Initiative.

Relevant disclosure declaration for all authors:
No disclosure.
Practice Patterns for Arthroscopy of Osteoarthritis of the Knee in the United States

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Objectives:
Knee arthroscopy is the most common orthopaedic procedure performed in the United States, and the surgical indications for this procedure were called into question by the 2002 publication of a randomized controlled trial of arthroscopy versus sham surgery by Moseley et al1. Their work showed arthroscopic knee surgery was not efficacious for patients with osteoarthritis (OA). The purpose of this study is to evaluate the change in knee arthroscopy rates for OA in ABOS Part II examinees after the publication of this article.

Methods:
We examined the ABOS database that includes 6 month case logs for each examinee sitting for the Part II board examination for the years 1999 - 2009. Knee arthroscopy cases were identified by CPT code and knee OA diagnosis was defined by ICD-9 code. Piecewise linear regression was used to evaluate the change in percent of knee arthroscopy cases for OA after the publication of the Moseley article in 2002; the model included adjustment for subspecialty and geographical region.

Results:
The number of knee arthroscopy cases for patients with OA has greatly decreased by 2009 after peaking in 2001 (1,621 vs 919 total cases, 2.36 vs 1.40 cases per surgeon). Cases classified as debridement have also decreased from 10.0% to 5.8% of knee arthroscopies (p=0.000). In addition, the total number of knee arthroscopy cases per surgeon has decreased from a high of 11.9 in 2003 to a low of 8.6 in 2009. As expected, knee arthroscopy as a percentage of total orthopaedic cases has also decreased from a high of 9.9% in 2003 to 6.6% in 2009 (p=0.000). Meniscectomy in patients with OA decreased after 2003 (31.0% of knee arthroscopy cases) to a low of 23.7% in 2006, but has since increased again in 2009 to 30.0% of cases. There was no difference in the rate of knee arthroscopy for OA when surgeons were stratified by geographical region and subspecialty.

Conclusions:
The rate of knee arthroscopy for patients with OA among orthopaedic surgeons during their ABOS examination case collection period has decreased after the publication of a landmark article demonstrating a lack of efficacy of this procedure. Further study is needed to determine if this change occurred in the orthopaedic community at large, or if practice patterns only changed for surgeons during their board collection periods.

References:

Relevant disclosure declaration for all authors:
No disclosure.
Loss of Knee Motion after ACL Reconstruction is Associated with Arthritic Changes after Surgery

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Objectives:
We sought to determine how rehabilitation to achieve normal knee range of motion might affect the incidence of arthritic changes observed on radiographs after ACL reconstruction.

Methods:
We prospectively followed patients after ACL reconstruction at a minimum of 5 years after surgery. Rehabilitation was refined through the years and the constant goal was to obtain full knee range of motion as quickly as possible after surgery and maintain it in the long-term. Range of motion and radiographs were evaluated according to IKDC objective criteria. Normal extension was considered to be within 2° of the opposite knee including hyperextension and normal knee flexion was considered to be within 5°. Radiographs were rated as abnormal if any sign of joint space narrowing, sclerosis, or osteophytes was present.

Results:
Follow-up was obtained for 780 patients at a mean of 10.5 ± 4.2 years after surgery. The percentage of patients who had normal radiographs was 71% for patients with normal extension and flexion and 55% for patients who had any deficit in range of motion ($P < .001$). For patients with intact menisci, normal radiographs were found for 77% of patients with normal motion versus 67% for patients who lacked normal motion ($P=.019$). For patients with medial meniscectomy, normal radiographs were found for 56% of patients with normal motion versus 38% for those without normal motion ($P=.035$). For patients with lateral meniscectomy, normal radiographs were found for 74% of patients with normal motion versus 41% for those without normal motion ($P < .01$). For patients with both medial and lateral meniscectomy, normal radiographs were found for 56% of patients with normal motion versus 24% for those without normal motion ($P = .021$).

Conclusions:
Rehabilitation to achieve full range of motion after surgery resulted in a lower incidence of arthritic changes on radiographs, regardless of meniscal status.

Relevant disclosure declaration for all authors:
No disclosure.
Effect of Acetabulum Rim Recession on Anterior Rim Angle: A Cadaveric Study

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Objectives:
The aim of the study was to examine the morphological changes within the cavity of the acetabulum upon completion of acetabulum rim trimming for pincer type FAI

Methods:
Eleven cadaveric hips were dissected exposing the acetabulum and femoral head. Specimens were marked 5mm from the 12 o'clock (superior) to 3 o'clock (anterior) position on the acetabulum. An osteotome was used to remove 5mm of the acetabular rim. The trimmed acetabulum was smoothed out using a dremel (Bosch Tool Corp, Mount Pleasant, IL). Pre- and post-operative radiographs were taken of the AP and false profile views of the hip socket. Measurements: Tönnis angle; center edge angle [CEA]; anterior rim angle [ARA], (Figure 1, angle between the line from the center of the femur head to the posterior inferior margin of the sourcil and the best fit line parallel to the anterior rim of the acetabulum); anterior wall angle (angle formed by the anterior wall and a horizontal line through sourcil); anterior margin ratio (the distance from the anterior rim of the acetabulum to the sourcil over the distance from the center of the femur head to the sourcil).

![Figure 1. Anterior Rim Angle of (a) pre-operative and (b) post-operative radiographs. Labels: A, center of femoral head; B, posterior sourcil; C, superolateral acetabulum; asterisk, anterior rim angle.](image)

Results:
The mean change values in: tönnis angle was 3.59° (range, 0.5° to 7.60°), with p-value < 0.5; CEA was 7.51° (range, 5° to 12.10°), p < 0.5; false profile CEA was 11.90° (range, 4.7° to 27.8°), p < 0.5; ARA was 4.71° ± 3.73° (range, 0.65° to 12.8°), p < 0.5; anterior wall angle was 5.55° (range, 2.1° to 9.3°), p < 0.5; anterior margin ratio was 9.4% (range, 2.1% to 17.8%), p < 0.5. The expected post-operative increase in ARA correlated with the reduction of the acetabular rim. The interclass correlation coefficient for radiographic measurement of the ARA was 0.91(95% confidence interval). Intraclass correlation coefficient was 0.99 for pre and post-operative ARA.

Conclusions:
A rim trimming procedure commonly used for the treatment of pincer type femoro-acetabular impingement (FAI) implements significant change on multiple measurements of the acetabular cavity. A consistent increase of the ARA and decrease of the anterior margin ratio on the post-operative acetabulum were both verified: two acetabulum measurements previously unrecognized or utilized in clinical evaluation. The new parameters, both ARA and anterior margin ratio, can be used as a means to further examine acetabular coverage pre- and post-operatively. This study provides a foundation for a more thorough interpretation of the changes of acetabular dimensions after surgical resection.

References:

Relevant disclosure declaration for all authors: No disclosure.
Acetabular Labral Tear Type in Relation to Bony Morphology of the Hip

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Objectives:
It has been postulated that bony morphology of femoral acetabular impingement may cause labral tears. Furthermore, it has been suggested labral tear patterns may reflect the mechanism of impingement: cam-type impingement may preferentially damage the chondro-labral junction, while pincer-type impingement may cause intrasubstance tearing. The purpose of this study is to report the correlation between labral tear type and the presence of pincer- vs. cam-type impingement.

Methods:
Between January 2008 and August 2010, 471 consecutive hip arthroscopies were performed for tears of the labrum. The majority of these tears occurred in the setting of femoral acetabular impingement. Labral tear type was recorded according to the classification proposed by Seldes: type 1) detachment of the labrum from the articular cartilage and type 2) intrasubstance tears of the labrum. For all patients, demographic information and measures of bony impingement were recorded, including alpha angle as measured by CT, MRI and Dunn view, acetabular inclination or the presence of cross over sign. These measures were compared between labral tear types to assess differences in bony morphology.

Results:
We found 175 patients with a type 1 labral tear, 137 with type 2 tear and 159 with a combined type 1 and 2 tear. Patients with a type 1 tear were significantly younger than the others, with a mean age of 35.2 years versus 39.9 (p < 0.0001). Acute injury was reported by fewer patients with a type 1 injury than the other patients (29.5% versus 39.6%, p Value < 0.05). We did not find any significant difference between the Seldes-type groups in relation to any measure of bony morphology or type of impingement.

Conclusions:
Relationship between bony morphology of the hip and labral tear type was not found. Detachment of the labrum from the cartilage was more common in younger patients. However, an acute injury is related more to an intrasubstance injury of the labrum than detachment. The results of this study do not support the concept that impingement type is a determinant of labral tear type.

References:

Relevant disclosure declaration for all authors:
No disclosure.
Performance Levels in Professional Hockey Players Following Arthroscopic Microfracture Surgery in the Hip

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Objectives:
Previous studies have reported that professional athletes can return to play following microfracture in the hip for full thickness chondral defects. Outcomes following microfracture of the hip have shown promising results. Performance measures have not been reported in the literature for professional hockey players following arthroscopic microfracture surgery in the hip. We hypothesized that professional hockey players undergoing arthroscopic microfracture for full thickness chondral defects of the hip would be able to achieve the same performance they had preinjury and those of matched controls.

Methods:
Between 2003 and 2009, 17 professional hockey players (NHL or AHL) underwent arthroscopic microfracture surgery for an Outerbridge grade IV chondral lesion of either the acetabulum or femoral head, performed by a single surgeon. Concomitant procedures, including procedures for labral pathology or FAI, were included. Performance data for the first full season preceding and following the index procedure were collected and analyzed. Data were obtained for 2 control players per subject matched by age, years in the league, and games played. Data were collected at 2 points, 2 years apart.

Results:
Eighty-two percent (14 of 17) returned to play professional hockey. There was no statistical difference between the treatment and control groups for age, number of seasons, games played, time on ice, points, save percentage (goalies), and shots against goal (goalies) (p<0.05). In the season following surgery, there was no statistical difference between the treatment and control group for performance measures. Treatment group had 25 minutes on ice and controls had 26, the treatment had 11.8 goals compared to 12.6 goals in the control, the treatment goalies had 89% saves while the controls had 90%, and the treatment group had 1045 shots against while the controls had 1114. Although not statistically significant, there was a trend towards a decrease in games played and points postoperatively compared with the controls. The treatment group had an average decrease of 11 games while the controls decreased by 5 games (p=0.4). The treatment group also saw a decrease in 14 points, while the controls saw a decrease of 3 points for the season (p=0.16).

Conclusions:
Following arthroscopic microfracture surgery in the hip, professional hockey players can play at the same high level when compared to preinjury status and matched controls based on objective performance measures.

Relevant disclosure declaration for all authors:
No disclosure.
Clinical Outcomes After Arthroscopic Psoas Lengthening: The Effect of Femoral Anteversion

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Objectives:
With technical advances in hip arthroscopy, release of a snapping psoas tendon is being performed with increasing frequency in symptomatic patients. However, reported clinical outcomes after this procedure are limited and the effect of variable femoral morphology on these outcomes remains undefined. The purpose of this study was to prospectively determine the effect of femoral anteversion on the clinical outcomes after arthroscopic lengthening of a symptomatic, snapping psoas tendon in young patients.

Methods:
Sixty-seven patients underwent arthroscopic lengthening of a symptomatic psoas tendon, either in isolation or in conjunction with treatment for femoroacetabular impingement and/or labral debridement or re-fixation. Preoperative CT scans defined proximal femoral morphology. Patients were divided into groups based on their femoral anteversion: low/normal (≤ 25°, n=48) or high anteversion (>25°, n=19). Prospective clinical outcomes were assessed pre- and postoperatively with modified Harris Hip Scores (mHHS) and Hip Outcome Scores (HOS).

Results:
Preoperative scoring showed significant differences with high version associated with worse HOS-Sport subscale but no difference with regard to mHHS and HOS - activities of daily living subscale. Postoperative outcome scores revealed a significant difference in MHHS with high version patients again having worse scores. Twice as many revision cases were in the high anteversion group.

Conclusions:
Patients with increased femoral anteversion may be at greater risk for inferior clinical outcomes after arthroscopic release of a symptomatic, snapping psoas tendon. The psoas tendon may be an important anterior stabilizer of the hip in these patients, and release may result in a greater alteration of kinematics and a delayed return to activities postoperatively.

Relevant disclosure declaration for all authors:
No disclosure.
Vitamin D Status in a Professional American Football Team

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Objectives:
Vitamin D deficiency has become an epidemic for all age groups in the United States and Europe. Vitamin D has been recently discovered to have numerous effects throughout many tissues, including skeletal muscle. We hypothesize that the prevalence of Vitamin D insufficiency is high in an American professional football team.

Methods:
Eighty-nine professional football players from a single NFL team underwent laboratory testing of Vitamin D levels in the spring of 2010 as part of their routine pre-season evaluation. The mean age of the players was 25.0 years old (s.d. 2.6, range 21-32). Data was obtained from the team to determine the number of players with time lost due to muscle injuries.

Results:
Twenty-seven (30.3%) players had deficient total vitamin D 25(OH) levels (<20 ng/mL). Forty-five (50.6%) players had levels consistent with vitamin D insufficiency (20-31.9 ng/mL). Seventeen players (19.1%) had values within normal limits (>32 ng/mL). There were 31 white players and 58 black players. The mean vitamin D level in white players was 30.3 (range 17-46 ng/ml) and 20.4 in black players (range 8-40 ng/mL) (p < 0.001). Seventy-three players had no muscle injury with a mean vitamin D level of 24.7 (range 9-46 ng/mL) and 16 players suffered a muscle injury with a mean vitamin D level of 19.9 (8-33 ng/mL) (p < 0.04).

Conclusions:
There is a high prevalence of vitamin D insufficiency (80%) identified in a professional American football team. Black players and players who suffered muscle injuries had significantly lower mean vitamin D levels. Due to these findings, we recommend screening and treatment of vitamin D insufficiency in professional athletics.

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No disclosure.
Long Term Follow-Up After Open Reduction and Internal Fixation of Olecranon Stress Fracture

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Objectives:

Introduction: Olecranon stress fracture is a rare injury associated with valgus extension overload in baseball players. No long term outcomes studies have been published documenting results of surgical fixation of olecranon stress fracture in baseball players.

Hypothesis: Open reduction and internal fixation of an olecranon stress fracture will allow for decreased pain and timely return at or above prior level of play in competitive baseball players.

Methods:

19 out of 26 (73.1%) patients greater than two years (Range 2-10.14 years) status post open reduction and internal fixation (ORIF) of an olecranon stress fracture were retrospectively contacted to complete a telephone survey. Data was collected to determine return to play rate and changes in arm pain and long term arm function.

Results:

18/19 (94.7%) of athletes returned to baseball, 17/19 (89.5%) at or above their previous level. Average return to play time was 29.4 weeks. Numeric analog pain scores decreased at rest and when throwing from 3.4 and 7.5 before surgery to 0.8 and 2.4 (p=0.00) upon return to play and 0.2 and 0.3 (p=0.00) at the time of follow-up, average 6.25 years (Range 2-10.4) after surgery. Average QuickDash score at follow-up was 3.84 (Range 0-27.3). 10 (52.6%) patients required 12 additional future surgeries on their throwing arm. 8 surgeries in 7 (36.8%) patients were not related to the index surgery. 6/19 (31.6%) required hardware removal, 2 (10.5%) for infection.

Conclusions:

Open reduction and internal fixation of olecranon stress fracture in competitive baseball players has a high rate of success in returning players to or above their former level of play, significantly decreases pain, and allows for good long term elbow function. However, these patients are at high risk for additional future surgery on their throwing arm.

Summary: ORIF of olecranon stress fracture with a single cannulated titanium screw allows for return to play at or above previous level, and significantly decreases pain without a long term negative effect on arm function.

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Relevant disclosure declaration for all authors:
Nothing to disclose.