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Annual Meeting Abstracts of the Society of Skeletal Radiology (SSR) 2019, Scottsdale, Arizona, USA

The Society of Skeletal Radiology will hold its Annual Meeting on March 10th-13th, 2019, at the JW Marriott Scottsdale Camelback Inn Resort & Spa, Scottsdale, Arizona. The following scientific abstracts will be presented.

Podium 1

NOMENCLATURE FOR SUBCHONDRAL NON-NEOPLASTIC BONE LESIONS

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(Presented by: Tetyana Gorbachova, MD)

Purpose: To provide an updated approach to the nomenclature of non-neoplastic conditions affecting the subchondral bone through a comprehensive review of the medical literature and the expert opinion of the Society of Skeletal Radiology (SSR) Subchondral Bone Nomenclature Committee.
Materials and Methods: A committee of 12 radiologists of the SSR was tasked with developing a consensus on nomenclature of subchondral non-neoplastic bone lesions. The committee was divided into subgroups assigned to specific sections and questions. Reviewers from each subgroup performed a literature review using a screening process based on article title and abstract, with predefined inclusion and exclusion criteria (original scientific papers that pertained to the key questions of each subgroup; study population of more than ten patients; English language abstract available). The subgroups reviewed the relevant literature and produced a draft of their respective sections, which were compiled by the committee chairs, and reviewed and edited by all committee members.
Results: Definitions of non-neoplastic abnormalities affecting the articular cartilage, subchondral bone and marrow, and descriptive terms pertaining to these lesions, such as osteochondral lesion, edema-like bone marrow lesion, osteochondral defect, bone contusion, subchondral fracture/insufficiency fracture, epiphyseal collapse and subchondral cyst, were provided. Recommendations for a nomenclature, based on literature review and consensus agreement, were performed. Clinicopathologic entities, such as osteochondritis dissecans, so-called transient osteoporosis of the hip and spontaneous osteonecrosis of the knee, avascular necrosis, and rapidly destructive osteoarthritis, were reviewed and recommendations on nomenclature were provided.
Conclusion: There is controversy on the nomenclature and pathophysiology of subchondral non-neoplastic bone lesions. This consensus statement is intended to summarize current understanding of the pathophysiology and imaging findings of these lesions, standardize and update the nomenclature and thereby improve patient management.

Podium 2

LOSS OF MUSCLE QUALITY IS CORRELATED WITH DECREASED BONE MINERAL DENSITY IN PATIENTS WITH SARCOMA

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(Presented by: Stephanie Jo, MD, PhD)

Purpose: Sarcopenia has been shown as a poor prognostic factor for patients with malignancies. We hypothesized that decreasing muscle cross sectional area (CSA) and increasing muscle fat infiltration would be associated with decreased BMD in patients with sarcoma.
Materials and Methods: 76 patients with sarcoma were retrospectively identified. The 1 year change in the muscle computed tomography (CT) attenuation and CSA of the pectoralis major at the sternoclavicular joint, and the erector spinae at T12 was correlated with the change in CT attenuation of the T12 vertebral body. Measurements were obtained on chest CT studies at diagnosis and 1 year after diagnosis. Correlations were evaluated using Pearson's correlation coefficients. Multivariable linear regression was used adjusting for patient age, sex, and height.
Results: The 1 year decrease in BMD at T12 was positively associated with the decrease in the CT attenuation (r=0.46, P=3.0x10-5, 95% CI (0.26, 0.62)) and CSA (r=0.30, P=0.008, 95% CI (0.08, 0.49)) of the pectoralis major, and positively correlated with the decrease in the CT attenuation of the erector spinae at T12 (r=0.43,9x10-5, 95% CI (0.23, 0.60)). No association was seen between the change in BMD at T12 and the change in CSA of the erector spinae at T12 (r=0.08, P=0.51, 95% CI (-0.15, 0.30)). These results persisted in the multivariate analysis: the 1 year change in BMD at T12 was associated with the change in the CT attenuation (P=8.6x10-5) and CSA (P=0.004) of the pectoralis major, and with the change in the CT attenuation of the erector spinae at T12 (P=0.0001), but not with the CSA of the erector spinae at T12 (P=0.23).
Conclusion: Increased fatty infiltration of the pectoralis major and erector spinae muscles was associated with decrease in spinal BMD

at T12. This study shows the important interplay between muscles and BMD in patients with sarcoma.

Podium 3

DIAGNOSIS OF SARCOPENIA IN THE RADIOLOGY DEPARTMENT: FEASIBLE AND SAFE?

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(Presented by: Robert Boutin, MD)

Purpose: Given that international consensus definitions of sarcopenia require assessment of both muscle function and muscle mass, our purpose was to examine the feasibility and safety of diagnosing sarcopenia at the point of care in the Radiology Department.
Materials and Methods: Consecutive patients > 65 years of age undergoing clinical FDG-PET/CT scans were prospectively offered enrollment. Functional evaluation included: [a] SARC-F assessment, [b] Frailty Risk Assessment (FRAIL scale), [c] grip strength, and [d] gait speed. The duration of the functional evaluation and any adverse events associated with this evaluation were recorded. CT evaluation of muscle was performed opportunistically at the L3 level, yielding two metrics: skeletal muscle density (SMD, in HU) and skeletal muscle index (SMI, muscle area in cm2/patient height in m2). Sarcopenia was diagnosed and classified into three stages according to modified EWGSOP criteria. Functional and imaging metrics were compared using Spearman correlations.
Results: 92/100 (92%) patients (45 M, 47 F; mean age, 74.6 years; sd, 5.8) agreed to participate and completed the clinical assessment. The duration of the functional assessment ranged from 3.5 to 6.0 minutes. There were no adverse events. Positive screening results by individual measures were: SARC-F (21/92, 23%), FRAIL (32/92, 35%), grip strength (19/92, 21%), gait speed (11/92, 12%), SMD (80/92, 87%), SMI (69/92, 75%). SMD was significantly correlated with SARC-F, FRAIL, grip strength, and gait speed (R=-0.30, p<0.01; R=-0.27, p<0.01; R=0.40, p<0.001; R=0.39, p<0.001, respectively). SMI was significantly correlated only with grip strength and gait speed (R=0.43, p<0.001 and R=0.29, p<0.01, respectively). Based on SMD, the group incidences of pre-sarcopenia, sarcopenia, and severe sarcopenia were 56.5%, 27.2%, and 2.2%; based on SMI, these incidences were 50%, 20.7%, and 2.2%.
Conclusion: Prospective collection of functional data and opportunistic CT data is both feasible and safe. Such an integrated approach allows the diagnosis of sarcopenia to be established in Radiology departments.

Podium 4

TRENDS OF FOLLOW UP RECOMMENDATIONS MADE ON MUSCULOSKELETAL MRI EXAMINATIONS

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(Presented by: Tony Wong, MD)

Purpose: To analyze trends in the follow up recommendations made on musculoskeletal MRI reports
Materials and Methods: An IRB-approved retrospective search identified 790 separate musculoskeletal MRI reports containing follow up recommendations from 1/1/2016-12/31/2017. A total of 774 reports were analyzed (excluding 16 exams that were incomplete or contained artifact). Meta-data was automatically extracted and follow up recommendations

were determined from manual review. Outcome data was determined by EHR and was available for 654 reports (120 were lost to follow up). Descriptive statistics and a chi-squared test were used for analysis.
Results: Types of recommendations: additional imaging (68%), obtain old studies (5%), clinical history/physical exam (14%), subspecialty consult (4%), lab-work (5%), intervention (7%) Recommendation compliance by clinicians: followed (73%) vs. not followed (27%) Recommendations followed by clinicians: Inpatient (74%) vs. Outpatient (73%); p = 0.77. After direct communication (93%) vs. no direct communication (71%); p < 0.001. Based on pathology: neoplasm (73%), trauma (73%), infection/inflammation/degenerative disease (73%), hardware (71%), vascular abnormality (77%); p = 1.0. Based on recommendation: additional imaging (67%), obtain old studies (72%), clinical history/physical exam (92%), subspecialty consult (69%), lab-work (76%), intervention (98%); p < 0.001. Recommendations acknowledged by clinicians: acknowledged (83%) vs. unacknowledged (17%). 73% of all unacknowledged recommendations were concern for neoplasm (locations: 41% abdomen/pelvis, 40% bone, 2% brain, 13% head/neck, 4% lung). Acknowledged/followed by subspecialty: Ortho (76%/64%), Rehab (86%/77%), Internal medicine (92%/85%), Non-Ortho Surgery (83%/75%), Other (92%/82%); (p < 0.001/p < 0.001).
Conclusion: Many recommendations made on musculoskeletal MRIs are not followed independent of patient location and type of suspicious pathology. Requests for additional imaging are least likely to be followed. The majority of unacknowledged recommendations are for suspicion of neoplasm. Direct communication with clinicians can increase compliance for follow up recommendations, which may be helpful in particular for orthopedic referrers.

Podium 5

MRI SEGMENTATION OF THE GLENOID AND HUMERAL HEAD USING DEEP CONVOLUTIONAL NEURAL NETWORKS

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(Presented by: Soterios Gyftopoulos, MD, MS)

Purpose: To present an automatic humeral head and glenoid segmentation method based on two-dimensional deep convolutional neural networks (CNNs).
Materials and Methods: The study received institutional review board approval. A retrospective dataset of volumetric structural MR images of the shoulder from 100 subjects, including 73 normal cases and 27 cases with a Hill-Sachs lesion and/or anterior glenoid bone loss in the setting of anterior shoulder instability, were manually segmented by experts. A 2D CNN architecture was trained with multiple initial feature maps and layers. Its segmentation performance was then tested against the gold standard of manual segmentation using four-fold cross-validation. The time needed to manually segment each shoulder MRI was documented for each case.
Results: Automatic segmentation of the humeral head achieved a mean average precision for object detection of 0.99, a dice similarity score of 0.95, a segmentation precision of 0.95, and recall of 0.95. The Hausdorff distance was 26.9mm, the mean square distance of 0.5mm, and the residual mean square distance of 1.5mm. For the glenoid, automatic segmentation achieved a mean average precision for object detection of 0.92, a dice similarity score of 0.86, a segmentation precision of 0.88, and recall of 0.86. The Hausdorff distance was 20.7mm, the mean square distance of 0.8mm, and the residual mean square distance of 1.8mm. On average, the time for manual segmentation ranged between 90 to 120 minutes per imaging study.

Conclusion: Using CNNs, we were able to accurately segment the humeral head and glenoid on MRI. Our results serve as an important initial step towards the automatic diagnosis and quantification of Hill-Sachs lesions and glenoid bone loss and determination of on/off track status. This, in turn, has the potential to provide consistently accurate imaging information that can be used to guide the selection of the most appropriate initial treatment for the anterior shoulder instability patient population.

Podium 6

MACHINE LEARNING CLASSIFICATION OF SOFT TISSUE MASSES OF THE PELVIS

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(Presented by: James Cortez, MD)

Purpose: Prospective classification of a soft tissue mass as benign or malignant remains challenging. We sought to develop a machine learning-derived decision tree for classification of soft tissue masses about the pelvis.

Materials and Methods: 5,334 consecutive musculoskeletal pelvis MRIs performed between 12/1/2014 and 8/31/2018 were retrospectively reviewed. 71 studies met inclusion criteria (absence of significant artifact, imaging prior to therapy initiation, and presence of DWI and of post-contrast sequences). Images were reviewed by a single musculoskeletal imaging fellow, assisted when needed by a fellowship trained attending with 6 years' experience. Assessed variables were: age, sex, T1 heterogeneity, presence of low T2 signal areas, whether lesion was mostly T2 hyperintense, internal fat, myxoid appearance on T2 and post-contrast images, peri-lesional "edema," longest dimension, and mean ADC of low-ADC, solid areas. Age, dimension, and ADC were continuous variables, and the remaining were binary. These data were used to build a decision tree for benign/malignant classification using the C4.5 algorithm (J48 classifier in Weka 3.8.2, University of Waikato, NZ) using 50% of the data for training, and the other 50% for validation. Results for the validation set are presented.

Results: Addition of DWI produced identical diagnostic performance. Decision points were size (cutoffs: 6.7 cm and 8.7 cm), perilesional "edema," lesion T1-heterogeneity, and age (cutoff: 55 years). Diagnostic performance was as follows. Sensitivity: 0.82 (95% CI: 0.48-0.98), specificity: 0.75 (95% CI: 0.53-.90), accuracy 0.77 (95% CI: 0.60-0.90) and positive and likelihood ratios: 3.3 (95% CI: 1.6-6.9) and 0.24 (95% CI: 0.07-0.87), respectively. Estimated area under the ROC curve: 0.790 (95% CI: 0.61-0.97).

Conclusion: We propose an algorithm for classification of soft tissue masses of the pelvis using standard, non-contrast MR imaging. The results would need to be validated in a larger data set.

Podium 7

COMPARISON OF "STIR-CT" TO CONVENTIONAL CT IMAGES FOR DETECTION OF MUSCLE LESIONS IN A BEEF SHANK MODEL

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(Presented by: Joshua Polster, MD)

Purpose: To compare the accuracy and diagnostic confidence between conventional CT images and an experimental processing technique for CT images termed "STIR-CT" that mimics a fluid-sensitive MRI sequence.

Materials and Methods: A model to mimic muscle strains was created using injected water in beef shank specimens. 7 specimens were used. 0, 1 or 2 lesions was created in each specimen by injecting 3 to 5 cc of tap water using a 22G needle. CT data was acquired using routine clinical protocol and reconstructed using soft tissue reconstruction (B40) at 3 mm slice thickness per clinical protocol with standard clinical window and level. A second set of images was created employing a "fluid-peak" look-up table to mimic the appearance of STIR MRI yielding 14 image sets (7 standard,7 STIR-CT). 4 musculoskeletal radiologists interpreted each data set in randomized order blinded to the number of lesions injected. For each suspected lesion, the lesion was pointed out and a confidence score was given.

Results: Aggregating all 4 readers, 100% of lesions (24 of 24) were identified correctly using STIR-CT images and 95.8% (23 of 24) were identified using standard images. There were a total of 5 false positives on STIR-CT imaging and 4 false positives on standard imaging. There was one false negative on standard imaging. Median confidence scores for correctly identified lesions were higher using the STIR-CT technique for 2 readers (100 vs 95; 87.5 vs 75) and the same for the other 2 readers however this was not statistically significant. Median confidence scores for false positive cases was higher using standard technique for 2 readers (100 vs 70; 95 vs 80).

Conclusion: More lesions were correctly identified and confidence scores were higher for some readers using the STIR-CT technique than conventional CT technique however the differences were not statistically significant.

Podium 8

CT-GUIDED BONE MARROW ASPIRATIONS AND BIOPSIES: RETROSPECTIVE REVIEW AND COMPARISON WITH BLIND PROCEDURES

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(Presented by: Connie Chang, MD)

Purpose: To compare the pathology results of CT-guided and blind bone marrow aspirations and biopsies.

Materials and Methods: This study was IRB-approved and HIPAA-compliant. 76 consecutive CT-guided and 70 blind posterior iliac crest bone marrow aspirations and biopsies performed between 1/2017-10/2017 were reviewed. All CT-guided biopsies used an 11-gauge battery-powered drill-assisted device. Blind biopsies used either the drill-assisted device or a 13-gauge manual biopsy device. Pathology reports were reviewed for adequacy of aspirate smears and biopsy samples (categorized as adequate, suboptimal, and not adequate) and core length. Patient age, gender, and body mass index (BMI), and core length were compared using Mann-Whitney (continuous) or chi-square/Fisher's Exact (categorical) tests.

Results: No significant difference was detected in the age (CT: median [25 and 75th percentile] 65 [56, 72] years; blind: 69 [57, 76] years; P = 0.1) or BMI (CT: 26.6 [23.1, 29.6]; blind: 27.3 [24.8, 32]; P =0.1) of the CT-guided and blind biopsy groups. The blind biopsy group (48 M, 22 F) had a higher proportion of males than the CT-guided biopsy group (38 M, 38 F; P = 0.02). More CT-guided aspirate smears than blind aspirate smears were categorized by the pathologist as adequate (CT: 72 (97%) adequate, 2 (3%) suboptimal, 0 inadequate, 2 no smear; blind: 58 (85%) adequate, 5 (7%) suboptimal, 5 (7%) inadequate, 2 no smeard; P = 0.02). More CT-guided biopsy samples than blind biopsy samples were categorized as adequate (CT: 72 (95%) adequate, 4 (5%) suboptimal, 0 inadequate; blind: 54 (77%) adequate, 9 (13%) suboptimal; 7 (10%) inadequate; P = 0.002). The CT-guided biopsies had longer aggregate core lengths (CT: 1.3 [0.9, 1.8] mm; blind: 1.0 [0.6, 1.2] mm; P = 0.001).

Conclusion: CT-guided bone marrow procedures were more likely to result in both adequate aspirate smears and biopsy samples when compared to blind bone marrow procedures.

Podium 9

ILIAC BONE MARROW BIOPSY AND ASPIRATION WITH FLUOROSOCOPIC GUIDANCE - EXPERIENCE WITH 775 CASES

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(Presented by: Jeremiah Long, MD)

Purpose: To evaluate the efficacy and safety of performing a fluoroscopically guided bone marrow aspiration and biopsy (BMAB) using a drill-powered needle in a large patient population.
Materials and Methods: This retrospective study received institutional review board approval with a waiver of patient informed consent. From August 2012 through December 2016, a total of 775 BMAB procedures were performed at a single institution using fluoroscopic guidance and a drill-powered needle. Clinical diagnosis, patient age, patient gender, biopsy site, biopsy needle gauge, bone marrow aspirate volume, bone marrow core biopsy length, patient platelet count, conscious sedation details, complications and diagnostic adequacy were investigated for each case and summarized.
Results: Samples obtained from the procedures in our series were diagnostic in 93% of cases. The complication rate for our series was 0.3% (2 episodes of hypoxia and 1 episode of supraventricular tachycardia, no fatalities). The patients in this study ranged in age from 16 to 91 years (average age 53 years). In cases where conscious sedation was utilized and details were recorded (738/775), the average sedation time was 21.1 minutes.
Conclusion: The use of fluoroscopic guidance and a drill-powered needle for bone marrow biopsy and aspiration is a safe and efficacious procedure.

Podium 10

STABLE VERSUS UNSTABLE OSTEOCHONDRAL LESIONS OF THE ELBOW: PERFORMANCE OF MR IMAGING CRITERIA FOR INSTABILITY

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Purpose: To retrospectively compare the performance of previously described magnetic resonance (MR) imaging criteria for the detection of instability in children with osteochondral lesions (OCL) of the elbow with clinical and arthroscopic findings as reference standards.
Materials and Methods: This IRB-approved, HIPAA compliant retrospective study included 45 elbow OCLs with MR studies from 43 children (mean age 13.1 years; range 9-17 years, 27 boys & 16 girls) diagnosed between April 1 2010 and May 31, 2018. Twenty-one lesions were stable, determined using arthroscopy or clinical assessment and 24 lesions were unstable, determined during arthroscopy. MR studies were retrospectively reviewed to determine the presence T2 high signal intensity rim, T2 dark signal intensity rim, surrounding cysts, subchondral disruption, overlying cartilage degeneration, fluid-filled osteochondral defect, and intra-articular fragments. Fisher Exact and Mann Whitney U tests were used.

Results: Demographic characteristics of children with stable and unstable OCLs demonstrated no difference in age (p=0.638) or symptom duration (p=0.646). Fluid-filled osteochondral defects (p=0.004) and the presence of subchondral disruption (p=0.007), overlying cartilage degeneration (p=0.006), and intra-articular fragment (p=0.002) were significantly more common with unstable OCLs. Lesion size (p=0.337) and the presence of T2 high signal intensity rim (p=0.555), T2 dark signal intensity rim (p=1), and surrounding cysts (p=0.236) were not significantly different between stable and unstable OCLs. Although, unstable OCLs were more likely to have larger cysts (up to 7mm) and more cysts (up to 5 cysts) than stable OCLs (up to 5mm and up to 2 cysts, respectively).
Conclusion: Only some of the previously described MR imaging criteria for lesion stability for the knee joint can be applied to predict stability of lesions in the elbow joint. This may be due to the high prevalence of unstable lesions presenting with a displaced fragment at the time of diagnosis.

Podium 11

THE SMOKE SIGN: A SIGN OF PECTORALIS TENDON HUMERAL INSERTIONAL INJURY ON ROUTINE SHOULDER MRI

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(Presented by: Devin Vaswani, MD)

Purpose: Study the diagnostic accuracy of the "smoke sign" on routine shoulder MR examinations for detection of pectoralis tendon humeral insertional injury.
Materials and Methods: IRB approved, HIPAA compliant study. Radiology database queried for MR with reports containing "pectoralis" and "shoulder" from 9/2012 to 7/2018. Patients without prior pectoralis surgery with shoulder and pectoralis MR within 4 months, and shoulder MR positive for pectoralis injury based on report and imaging review that clearly depicted pectoralis injury were included. Anonymized, randomized shoulder MR reviewed independently by two musculoskeletal fellowship-trained radiologists for "smoke sign" on coronal- and sagittal-oblique sequences. Teaching session provided guidelines for smoke sign (ill-defined edema lateral or anterior to short head biceps/ coracobrachialis on coronal- and sagittal-oblique fluid-sensitive images, respectively) before reader review. All MR reviewed by senior author for presence and location of pectoralis injury.
Results: 52 shoulder MR exams total: 33 patients with shoulder and pectoralis MR, 4 patients with shoulder MR and pectoralis imaging on same exam, 15 patients with shoulder MR only.14/52 exams didn't have pectoralis injury on shoulder or pectoralis MR; "smoke sign" was present in none of these cases. Remaining 38 patients had pectoralis injuries; 24/38 (humeral avulsion), 4/38 (tendon tear) 8/38 (myotendinous junction), 2/38 (intramuscular injury). Pooled sensitivity, specificity, negative and positive predictive value for "smoke sign" was 86%, 100%, 76% and 100%. When only tendon tears and avulsions were assessed, this rose to 100%, 100%, 100% and 100%. Kappa coefficient was 0.922 for the presence of the sign on coronal oblique 0.876 on sagittal oblique images. Smoke sign was present in all 8 surgically proven pectoralis injuries.
Conclusion: "Smoke sign" is sensitive and specific for pectoralis humeral insertional injury, especially tendon tears and avulsions. Detection of this sign on routine shoulder MR should prompt careful evaluation of the distal pectoralis tendon and recommendation for dedicated pectoralis imaging.

Podium 12

MAGNETIC RESONANCE IMAGING FINDINGS IN THE FAILED SUPERIOR CAPSULAR RECONSTRUCTIO

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(Presented by: Harry Greditzer, MD, MS)

Purpose: Superior capsular reconstruction (SCR) of the shoulder is an increasingly common procedure in the treatment of patients with massive, irreparable rotator cuff tears in the absence of significant osteoarthritis. Post-operatively, the normal appearance of well-functioning grafts on magnetic resonance imaging (MRI) has been well characterized. However, the appearance of failed grafts has only been described in isolated case reports and general review articles. The purpose of this study was to examine the MRI features of all failed SCRs at a single institution over a two-year period.
Materials and Methods: Following Institutional Review Board approval, surgical records at a single tertiary-care facility were queried to identify all patients undergoing SCR from January 2016 through December 2017. Electronic health records were reviewed for patient demographic information, reason for post-operative MRI, and post-operative surgeon assessment.
Results: 74 patients underwent SCR over the study period, of whom 12 received a follow-up MRI post-operatively. One patient was excluded due to missing records; the remaining 11 patients comprise the study cohort. Post-operative MRIs were obtained at mean six months after surgery. On review of post-operative MRIs, three distinct locations of failure were identified. Four patients (40%) had midsubstance failure of the allograft with all glenoid and humeral head fixation remaining intact. One patient (10%) had complete detachment of the allograft from both glenoid and humeral head fixation. Five patients (50%) had detachment of the allograft from the glenoid.
Conclusion: In this series of ten failed SCRs, the most common mode of failure was loss of fixation on the glenoid, followed closely by midsubstance rupture. We found no instances of isolated fixation failure on the humeral head. This series illustrates the need for careful imaging in patients whose post-operative course suggests clinical failure. These findings also suggest that strengthening glenoid fixation may provide better clinical outcomes as this procedure becomes more common.

Podium 13

PREVALENCE OF PSEUDOEROSIONS OF THE HAND AND WRIST: ULTRASOUND FINDINGS IN 100 ASYMPTOMATIC VOLUNTEERS

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(Presented by: Anna Falkowski, MD, MHBA)

Purpose: Identification of cortical erosions with ultrasound can indicate inflammatory arthritis. While cortical depressions have been described in several metacarpal heads that may simulate an erosion, we have noted similar "pseudoerosions" more frequently than prior descriptions, and with more extensive involvement of the wrist. Thus, our purpose is to evaluate the frequency and location of these pseudoerosions in asymptomatic volunteers.

Materials and Methods: After IRB approval and obtaining informed consent,100 subjects without hand or wrist symptoms were examined bilaterally with ultrasound. Dorsal metacarpal heads, lunate, triquetrum, and distal ulna were examined. Cortical depressions were characterized with regard to location (central, marginal, both), morphology (irregularity, ring-down artifact), and dimensions (length and depth) by two fellow-trained musculoskeletal radiologists in consensus.
Results: 100 patients were evaluated (52 male, 48 female; mean age of 47 ± 16 years). Metacarpal (MC) heads showed a central pseudoerosion in various frequencies (MC1: 21.5%; MC2: 92%; MC3: 85.5%; MC4: 59.5%; MC5: 81%). Only one marginal erosion was present at a MC5 and a marginal plus central at a MC2. Pseudoerosions were present at the lunate (82%), triquetrum (84%), and distal ulna (20%), and were multiple (lunate: 40%; triquetrum: 27%, ulna 5%). Ring-down artifact (30.25-49.7%) was present more than cortical irregularity (12.6-27.9%) of the pseudoerosions. Mean pseudoerosion length and depth of MC was 3 mm (range: 0.6-9 mm) and 0.7 mm (range: 0.2-8), respectively. Wrist dimensions for pseudoerosions varied slightly for the lunate (length: 2.1; depth: 0.8), triquetrum (length: 1.7; depth: 1.0), and ulna (length: 1.7; depth: 1.1) with a range of 0.3 – 6 mm in length and 0.3 – 5 mm in depth.
Conclusion: Central pseudoerosions are a typical finding of metacarpal heads, lunate, triquetrum, and distal ulna in asymptomatic patients and should not be misinterpreted as inflammatory arthritis.

Podium 14

SUPRASPINATUS AND INFRASPINATUS TENDON TEARS: NEW INSIGHTS ON LOCATION FROM RECENT ANATOMIC STUDIES

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(Presented by: Michael Tuite, MD)

Purpose: Use recent anatomic descriptions of supraspinatus (SST) and infraspinatus (IST) tendons to determine which is more commonly torn.
Materials and Methods: We reviewed operative reports of 100 consecutive patients with shoulder MRs followed by arthroscopy within 1 year with $\leq$ 2cm tear at surgery. There were 52 full thickness-, 32 articular partial-, 8 bursal-, and 8 with articular and bursal tears. We measured the greatest AP and Med-Lat dimensions. The junction between the superior and middle facets was identified by its inflection in the greater tuberosity cortex; we measured the AP distance of the margins relative to this junction, and Med-Lat distance to the medial greater tuberosity. A scale drawing of the SST and IST modeled on recent papers was created and an oval representation of each tear was overlayed to determine tendons involved. Tears were remeasured 6 months later by the lead author, and by a senior radiology resident, for intra- and interobserver variability.
Results: The most common location for a tear was 8-10mm anterior to the junction between the facets, and 2mm medial to the medial edge of the tuberosity. The center of the tear was in the SST in 75 tears, in the IST in 26, in the SST-IST overlap in 5, and at the junction of SST and IST in 2. The SST only was involved in 37 tears, and the IST only in 10. Both the SST and IST were torn in 61; the tear involved $\leq$1mm of 1 of 2 tendons in 8, and between 1-2mm in 13. Intraobserver correlation coefficient was 0.90; interobserver coefficient was 0.66
Conclusion: 74% of tears are centered in the SST or the SST/IST overlap. Of tears centered in the SST, 73% involved 0-2mm of the IST.

Podium 15

LOSS OF REDUCTION IS COMMON AFTER CORACOCLAVICULAR LIGAMENT RECONSTRUCTION

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(Presented by: Brian Kennedy, MD)

Purpose: Soft tissue reconstruction of the coracoclavicular ligament is an increasingly common treatment approach for significant acromioclavicular joint separation injury. We have anecdotally noted loss of acromioclavicular joint reduction, coracoclavicular interval widening, distal clavicular osteolysis, and widening of osseous tunnels on follow-up radiographic exams. Our purpose is to report radiographic features and complications following coracoclavicular soft tissue reconstruction.
Materials and Methods: Retrospective query of our imaging database identified 55 cases of coracoclavicular ligament reconstruction. Cases with at least one month of follow-up and available operative report were reviewed with attention to : 1. alignment of the acromioclavicualar joint, 2. coracoclavicular interval widening, 3. radiographic features of distal clavicular osteolysis, and 4. widening of the reconstruction tunnel.
Results: 32 patients with post-operative imaging following coracoclavicular ligament reconstruction (23 male, 9 females; average age 43, age range 24-64, imaged 1 to 34 months following surgery, average 9.5 months) were included. Loss of acromioclavicular joint reduction was the most common imaging finding at follow-up (n = 25, 78%), with 88% of cases seen within 6 months of surgery. 19 (76%) patients with loss of acromioclavicular reduction progressed to coracoclavicular interval widening. Distal clavicular osteolysis was seen in 21 patients (66%), with 90% of cases seen within 6 months of surgery. Reconstruction tunnels widened on average 2 mm (range 0 – 4 mm). Revision surgery was required in 5 patients (16%), with 80% of revisions occurring more than a year following surgery.
Conclusion: Loss of acromioclavicular joint reduction, distal clavicular osteolysis, and tunnel widening are frequently demonstrated after coracoclavicular ligament reconstruction. Radiologists should be aware of the frequently observed imaging findings following coracoclavicular reconstruction. Attention to early loss of reduction or distal clavicular may guide treatment approach and impact patient outcomes.

Podium 16

POSTERIOR ELBOW DISLOCATION. MRI IMAGING FEATURES AND PATHOPHYSIOLOGIC CONSIDERATIONS

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(Presented by: Michael Zlatkin, MD)

Purpose: To examine soft tissue and osseous injuries visualized on magnetic resonance (MRI) imaging after posterior elbow dislocation, and to correlate these injury patterns with pathophysiologic mechanisms.
Materials and Methods: Retrospective review of 16 patients with posterior elbow dislocation, obtained searching the institutional computer database spanning a 60-month period.
Results: Soft tissue injuries: Six patients (37.5%) had complete disruption of the lateral and medial collateral ligament complexes. Two patients (12.5%) had disruptions of the lateral ligament complex, along with partial disruption of the medial collateral ligament

(MCL). These two groups conform to Stage 3 *posterolateral rotatory dislocation (PLRD)*. Six patients (37.5%) had complete MCL complex disruption associated with partial disruption of the lateral ligament complex consistent with a less commonly described *posteromedial rotatory dislocation pattern ((PMRD)*. The remaining 12.5% of patients had partial disruptions of both the MCL and LCL ligament complex. Injuries of the common extensor and common flexor tendons accompanied the ligament tears. Grade 1 or 2 strain of the brachialis muscle was identified in all patients. Bone injuries:Eleven (68.8%) patients had fractures or osteochondral injuries involving one or more sites, either the coronoid process 31.3% (n=5), radial head 25% (n=4), capitellum 18.8% (n=3), and/or trochlea 6.3% (n=1).
Conclusion: MR imaging demonstrates the soft tissue and osseous injury patterns after posterior elbow dislocation. The *posterolateral rotatory dislocation* pattern, with sequential ligament disruption from lateral-to-medial, does not occur in all patients. The pattern of ligament disruption in our series, supports the notion that in a subset of patients, the injury pattern appears to progress from medial to lateral, indicating a *posteromedial rotatory dislocation pattern*. Recognition of patterns of injury may have implications on patient management.

Podium 17

ULTRASOUND-MRI CORRELATION FOR HEALING OF ROTATOR CUFF REPAIRS USING VASCULARITY AND TENDON ELASTICITY: A PILOT STUDY

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(Presented by: Ronald Adler, MD, PhD)

Purpose: To better understand alterations in repaired supraspinatus tendons using a multimodality approach including MRI, assessment of tendon vascularity by power Doppler (PD), and tendon mechanical properties using shear wave elastography (SWE). To investigate whether SWE and PD can provide quantitative assessment of tendon healing following rotator cuff repair.
Materials and Methods: This HIPAA compliant prospective study was approved by the institutional review board with informed consent. Between 9/2013 and 6/2016, twelve patients (7 males, 5 females; mean age 61 years) with unilateral full-thickness supraspinatus tendon tears underwent MRI and ultrasound pre-operatively, 3-months and 6-months post-surgery. The supraspinatus tendon MRI signal intensity, PD and SWE properties were measured. Repaired and asymptomatic shoulders were compared over time within and between modalities.
Results: No significant association was seen between mean SWE and MRI signal intensity (non-insertional portion -0.25, p=0.467, insertional portion -0.18, p=0.593), or between PD and MRI signal intensity (non-insertional portion -0.19, p=0.599, insertional portion 0.22, p=0.533) within the supraspinatus tendon. MRI signal intensity and PD within the supraspinatus tendon, both increased and then decreased postoperatively. Shear wave velocities increased throughout the postoperative period in the tendon footprint, while increasing and then decreasing in the distal tendon.
Conclusion: MRI and ultrasound parameters did not achieve statistically significant correlation; however, their respective trend behavior suggests that a temporal relationship exists between modalities. We postulate that a more detailed multiparametric imaging approach and/or comparison with a more selective MR measure, such as T2* values, may be required to evaluate rotator cuff repair.

Podium 18

PLATELET-RICH PLASMA FOR TREATMENT OF MODERATE-TO-SEVERE MIDSUBSTANCE ACHILLES TENDINOPATHY: A PILOT RCT WITH CONVENTIONAL AND NOVEL ULTRASOUND IMAGING CORRELATION

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(Presented by: David Gimarc, MD)

Purpose: To investigate the efficacy of PRP for the treatment of midsubstance Achilles tendinopathy (AT) and to correlate clinical outcomes to conventional ultrasound and novel quantitative shear wave elastography.
Materials and Methods: 20 subjects were recruited from April 2014 to November 2017 with moderate-to-severe midsubstance AT and randomized into two groups. Inclusion criteria: 1) age 18-65 yo, 2) pain > 6 months and VAS pain >5, 3) failure of eccentric exercise protocol, and 5) failure of conservative treatments. Exclusion criteria: 1) steroid injection within 6 weeks, 2) past surgery or systemic diseases. Group 1 (PRP) received a single injection of PRP at week 0. Group 2 (control) did not receive an intervention and continued to perform eccentric exercise. Pain and function were evaluated using the validated VISA-A clinical outcome questionnaire (primary outcome) and VAS pain levels at 0, 12 and 24 weeks. Disease modification was assessed by conventional US (tendon thickness, echotexture, hyperemia) and shear wave speed elastography (SWS) at week 0, 12 and 24 weeks. Linear mixed model and ANOVA tests applied with $p<0.05$ significance.
Results: 20 subjects (7 women and 13 men), mean age 54.7 years (range 38-65 yo) recruited. Baseline characteristics showed no statistical difference between groups. PRP group VAS scores were 6.9, 1.4, and 1.3 and VISA-A scores were 46.7, 60.4, and 83.3 at 0, 12, and 24 weeks, respectively. Control group VAS scores were 7.2, 7.4, and 6.2 and VISA-A scores were 40.4, 39.2, and 51.5 at 0, 12, and 24 weeks, respectively. Baseline SWS for normal and abnormal tendons averaged 10.99 m/sec and 9.81 m/sec, respectively. No significant difference found in tendon thickness, echotexture or vascularity over time.
Conclusion: PRP is an effective treatment alternative for chronic moderate-to-severe midsubstance Achilles tendinopathy. Imaging outcome measures may not be a reliable biomarker for tendon healing.

Podium 19

TO DRILL OR NOT TO DRILL, THAT IS THE QUESION

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(Presented by: Kevin He, MD)

Purpose: At our institution, requests for extraspinal bone biopsies for suspected osteomyelitis are relatively common. Over the past several years, we have observed that the culture yield for such biopsies is frustratingly low. Hence, the objective of our study was to evaluate the yield and treatment impact of CT-guided extraspinal bone biopsies performed for infection over a 10 year period.
Materials and Methods: An IRB-approved retrospective review of CT-guided bone biopsies between 2008 and 2018 was performed. Of 855 biopsies, 35 were performed for suspected osteomyelitis; all spine biopsies were excluded from the study. Biopsies were performed with CT guidance utilizing a 12 or 14G AprioMed Bonopty system. A chart review was performed to ascertain the following for each procedure: pathology results, culture results, open biopsy results when applicable, and clinical course prior to and after biopsy, including antibiotic therapy.
Results: Out of 35 cases, 17 (49%) were positive on pathology for osteomyelitis, 5 (14%) yielded positive cultures, and 4 (11%) demonstrated positive open biopsy cultures after initial negative CT biopsy cultures. There were 5 cases of starting or changing to targeted antiobiotic therapy after positive CT biopsy cultures, 5 cases of starting or continuing antibiotics after positive CT biopsy pathology but negative cultures, and 2 cases of cessation of antiobiotic therapy after negative CT biopsy pathology and cultures, totalling 12 cases (34%) in which treatment was appropriately affected. 6 cases of starting antibiotic therapy despite negative CT biopsy pathology and cultures and 6 cases of not initiating antibiotic therapy despite positive CT biopsy pathology showing chronic osteomyelitis but negative cultures were also observed.
Conclusion: The culture yield for CT-guided extraspinal bone biopsies is extremely low and, at our institution, the majority of biopsies did not change clinical management.

Podium 20

CT-GUIDED BONE BIOPSY IN CHRONIC NON-SPINAL OSTEOMYELITIS: FRUITFUL OR FUTILE?

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(Presented by: Jan Fritz, MD)

Purpose: To determine the frequency of CT-guided bone biopsy resulting in the identification of a causative pathogen and tailoring of antibiotic treatment in patients with chronic non-spinal osteomyelitis.
Materials and Methods: Following internal review board approval, we identified 181 patients (mean age, 52 years; age range, 20-93 years) with chronic osteomyelitis, who underwent successful non-spinal CT-guided bone biopsy and subsequent microbiological examination. Biopsies were performed in the foot (65/181, 36%), pelvis (75/181, 41%), and other locations (41/181, 23%). The outcome variables included a) diagnostic yield, defined as the identification of a pathogen through microbiological analysis, b) resulting changes of antibiotic treatment, and c) microbiological results from wound cultures. Descriptive statistics were applied. P-values less than 0.05 were considered statistically significant.
Results: The diagnostic yield of CT-guided bone biopsies was 18%, meaning that in 33 of 181 biopsy cases microbiological analysis identified a pathogen conclusively. In 16/75 (21%) pelvis cases and 9/65 (14%) foot and ankle cases, the microbiological analysis was conclusive for a causative pathogen. 18/33 (55%) conclusive cases also had wound cultures performed, of which 14 (42%) had the same organisms identified in both the wound and bone biopsy specimen cultures. In the 33 cases with conclusive microbiological analysis, the isolated pathogen resulted in adaption of the antibiotic treatment in 31/33 (94%).
Conclusion: CT-guided bone biopsy in patients with chronic non-spinal osteomyelitis may result in the identification of a causative pathogen in only 18% of cases and adaptation of antibiotic treatment in only 17% of cases. Taking into consideration the 42% concordance rate of bone and wound cultures, the diagnostic yield of CT-guided biopsy may decrease to 10%. Our study results indicate a limited role of CT-guided bone biopsy in the management of patients with chronic non-spinal osteomyelitis.

Podium 21

DIAGNOSTIC YIELD OF IMAGE-GUIDED SYNOVIAL BIOPSY FOR INTRA-ARTICULAR SYNOVIAL LESIONS

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(Presented by: Jeffrey Belair, MD)

Purpose: A variety of benign and neoplastic lesions can affect the synovium, the most common including pigmented villonodular synovitis (PVNS) and synovial chondromatosis. Recent treatment advances have opened the door for potential medical therapies for PVNS, which could decrease or eliminate the need for surgery in some cases. Accurate characterization of synovial lesions is thus required prior to treatment.

Materials and Methods: Institutional IRB approval was obtained. 52 synovial biopsies performed under ultrasound (US) or computed tomography (CT) guidance at our institution for intra articular synovial lesions were identified using a comprehensive database search. Cases were reviewed for pathology, location, biopsy approach, preprocedure imaging, and postprocedure complications.

Results: 52 image guided synovial biopsies were performed, 34 using CT guidance and 18 using US guidance. Five different anatomic locations were biopsied (hip, knee, shoulder, elbow and TMJ). Synovial tissue was obtained in 87% of cases (45/52) and the final diagnosis was established in 81% of cases (42/52). CT-guided biopsies had positive yield in 86% of cases (29/34) and established the final diagnosis in 78% (27/34) of cases. US-guided biopsies had positive yield in 89% (16/18) and established the final diagnosis in 83% (15/18). Post-surgical pathology was obtained in 28 of the cases and image-guided biopsy concordance was 100% (28/28). There were no reported complications. Anecdotally, we found that intra-articular injection of iodinated contrast prior to CT-guided biopsy may be useful for accurately identifying the target lesion.

Conclusion: Image-guided synovial biopsy is a safe procedure with a high diagnostic yield. The final diagnosis can be established in the majority of cases.

Podium 22

SHORT-TERM EFFICACY OF ULTRASOUND-GUIDED RETROCALCANEAL BURSA STEROID INJECTION AND CORRELATION WITH SONOGRAPHIC IMAGING FEATURES

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(Presented by: Robert Uzor)

Purpose: Posterior heel pain due to retrocalcaneal bursitis and/or insertional Achilles tendinopathy is commonly treated with sonographically-guided steroid injection, but the efficacy of this treatment is not well understood. The purpose of this study was to evaluate the clinical effectiveness of ultrasound-guided corticosteroid injection into the retrocalcaneal bursa as a treatment for posterior heel pain and to correlate the pre-injection heel sonographic findings with injection outcome.

Materials and Methods: After IRB approval, consecutive sonographically-guided retrocalcaneal bursa injections (2015-2018) were retrospectively reviewed. Pre-injection heel ultrasound features (presence of Achilles tendinopathy, retrocalcaneal bursitis, bursal or tendon Doppler flow) and pre-and post-injection patient VAS pain scores (scale 0-10) were recorded. Response to treatment was classified as excellent (reduced by 7-10 points), good (reduced by 4-6 points), fair (reduced by 1-3 points), or none. The Fisher exact test was used to evaluate for associations between each ultrasound finding and injection outcome.

Results: 27 injections were performed (22 females, 5 males; mean 55.2 years, range 35-68 years; 13 left heel, 14 right heel), with 100% technical success and no complications. Insertional Achilles tendon pathology and retrocalcaneal bursitis was sonographically present in 24 of 27 cases (89%) and 17 of 27 (63%), respectively. Median pre-procedure and post-procedure (within 1-4 weeks) pain scores were 10 (IQR 8, 10) and 3 (IQR 0, 5), respectively. Statistically significant decrease in pain score was observed following injection, with good or excellent response (> 4-point reduction in pain score) present in 70% of patients, and mean change of 5.18 (95% CI 3.81, 6.56; p<0.00001). No significant correlation was identified between change in pain score and sonographic variables.

Conclusion: Sonographically-guided retrocalcaneal bursal steroid injection is an effective technique yielding statistically significant short-term decrease in pain score, with a mean change of 5.18 (p<0.00001).

Podium 23

SAFETY AND EFFICACY OF IMAGE GUIDED RADIOFREQUENCY ABLATION OF GENICULAR NERVE FOR PAIN MANAGEMENT IN PATIENTS WITH MODERATE TO SEVERE OSTEOARTHRITIS OF THE KNEE: INITIAL SINGLE INSTITUTION EXPERIENCE

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(Presented by: Felix Gonzalez, MD)

Purpose: To assess the safety-efficacy of RFA for treatment of moderate-severe knee arthritis pain.

Materials and Methods: 8-patients refractory to conservative treatments underwent genicular nerve RFAs. Anesthetic blocks were followed by RFA 1-2 weeks afterwards. Treatment efficacy was evaluated using the WOMAC index before and at 3 months.

Results: A total of ten knees were treated in 8 patients. The average age of the patients was 70.9 years. Mean follow-up time was 3.5 months. No procedure related complication was identified. The mean total WOMAC score (out of 100) improved significantly from baseline score of 47 to 65.9 at 3 months post treatment (p=0.019). Subanalysis of the overall symptoms component of the WOMAC questionnaire demonstrated significant decrease in mean overall symptoms score from 11.4 to 7.3 (p=0.046). Mean stiffness score decreased from 6.2 to 3.5 (p=0.003) and mean pain score decreased from 22.5 to 13.3 (p=0.026). There was also significant improvement in the functional daily living limitations with mean baseline score of 30.2 and 3 month post therapy score of 20.3 (p=0.037).

Conclusion: Imaged-guided radiofrequency ablation of genicular nerves is a safe treatment option resulting in significant improvement in osteoarthritic index, motility and quality of life in patients with moderate to severe knee OA refractory to conservation treatments.

Podium 24

MUSCULOSKELETAL (MSK) SOFT TISSUE LESION CORE NEEDLE BIOPSY: VARIATIONS IN BIOPSY PRACTICE PATTERNS AND IMPLICATIONS REGARDING SPECIMEN ADEQUACY

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(Presented by: Anthony Wheeler, MD)

Purpose: To investigate variations in MSK soft tissue biopsy practice patterns in an effort to determine if a best practice exists in regard to obtaining adequate specimens for pathologic diagnosis.
Materials and Methods: A 17 question Survey Monkey® questionnaire was created to poll SSR members performing MSK soft tissue core biopsies. Demographic questions and questions pertaining to biopsy technique (e.g. needle type, needle gauge, number of passes, specimen length, and verification method of specimen adequacy) were posed. The email survey was distributed to the SSR membership on March 22, 2018, with a completion reminder sent on May 7, 2018. A statistical analysis of collected survey data was performed. A Pearson Chi Square test was used to compare proportional differences of completed biopsy techniques questions and specimen adequacy questions. A multiple comparison Bonferroni adjustment was applied where p-values < 0.007 were statistically significant. All tests were two sided.
Results: 147 of 1454 (10.1%) of members responded to the survey. Of those responding, 85 (57.8%) described their practice as academic, 49 (33.3%) as private practice and 13 (8.8%) as hybrid. The majority (87.1%) perform needle core biopsy and/or FNA of soft tissue lesions. The majority (94.9%) were MSK fellowship trained. There were no statistically significant associations between needle size or type, number of samples obtained, or in-room verification of specimen adequacy with the percentage of time final pathology specimens were deemed non-diagnostic/inadequate (p>0.067 for all analyses).
Conclusion: There is considerable variation in MSK soft tissue tumor biopsy technique among SSR members. However, no statistically significant correlation between the various biopsy techniques and the probability of a non-diagnostic specimen was found.

Podium 25

UTILITY OF REPEAT HIP ASPIRATIONS PERFORMED ON PATIENTS WITH THA

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(Presented by: Michael Fox, MD)

Purpose: Evaluate the utility of a repeat hip aspiration performed within 15 days of the first aspiration in patients with total hip arthroplasty (THA).
Materials and Methods: All hip aspirations performed over a 10 year period (2007-2017) at a single institution were retrospectively reviewed. Data recorded included patient age, gender, laterality, interval between aspirations, volume of fluid returned, whether a "joint lavage" was performed, cell count, culture, and fluoro time. Differences between the first and second aspiration that were studied included: Volume returned, Culture result, and Total synovial WBC count.
Results: 27 patients (17F:10M; mean age 66.3) had 31 "pairs" of aspirations on 29 hips (15R:14 L). The mean/median number of days between 1st and 2nd aspirations was 8.1/8.0 days respectively. The mean/median volume (mL) returned was 9.9/2.0. Mean/median volume change between 1st and 2nd aspirations was 5.6/0.0. No fluid was returned in 13% (4/31) of the first attempts; however, all 4 had fluid on the second attempt (mean 3 mL/median 2mL). In the 16 instances when <2 mL of fluid was returned on the 1st aspiration, the 2nd aspiration yielded <1 mL in 19% (3/16); 1-1.9 mL in 31% (5/16), and 2+mL in 50% (8/16) of the cases, respectively. In 54% (7/13) of the 2nd aspirations that returned >1mL, either a positive culture or a synovial WBC of >10,000 was revealed. Mean and median fluoroscopic time was 0.6 and 0.5 minutes.
Conclusion: In 81% (13/16) of THA patients with an initial aspiration of <2mL, a repeat aspiration returned 1+ml of fluid. In over 50% of those 13 patients, a positive culture result or an elevated synovial WBC was evident. When no fluid was returned on the first attempt, at least 1 mL of fluid was returned on repeat aspiration in all cases.

Podium 26

AIIS AND SUBSPINOUS IMPINGEMENT ON MRI: WHEN TWO BECOME ONE

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(Presented by: Terence Farrell, MD)

Purpose: The morphology of the anterior inferior iliac spine (AIIS) and subspinous region are increasingly being identified as important components in the spectrum of extra-articular hip impingement (EA-HI). The purpose of this study in progress is to detail the normal spectrum of morphology and imaging appearance of the AIIS and subspinous region on MRI, demonstrate variant morphology and pathology of these regions associated with EA-HI, highlight the distinct nature of these two entities with MRI patterns and discuss appropriate imaging protocols in the evaluation of EA-HI.
Materials and Methods: A retrospective MRI report database was searched for "subspinous", "AIIS impingement", "rectus femoris tendinosis" and "bursitis" with "anterior". An MRI indication database was searched for "subspinous", "AIIS" and "extra-articular" with the term "impingement". Identified MRIs were reviewed by two MSK rads in consensus for AIIS anatomy, sub-spinous space size, rectus femoris origin pathology, bursitis, soft tissue edema and acetabular labrum tear. Exclusion criteria included fracture, osteoarthritis and active core injury.
Results: 30 subject group MRIs were reviewed along with 10 control group studies. There was great variability in the subspinous space, but the distance was smaller in the setting of soft tissue edema anterior to the hip capsule. Rectus femoris tendinosis varied from tendinous enlargement to peritendinous edema, but was isolated to the subject group. Anterior labrum tears were present in both groups without statistically significant difference. A constellation of AIIS prominence, rectus femoris tendinosis and pericapsular soft tissue edema was exclusive to the subject group.
Conclusion: AIIS impingement and subspinous impingement are separate entities in closely apposed regions which frequently coexist as causes of EA-HI. The clinical presentation may be analagous to CAM/pincer type femoroacetabular impingement and a high index of suspicion and knowledge of normal AIIS and subspinous anatomy, variant morphology and pathology is crucial to accurately diagnose and treat EA-HI.

Podium 27

SONOGRAPHIC EVALUATION OF THE LATERAL FEMORAL CUTANEOUS NERVE IN MERALGIA PARESTHETICA

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(Presented by: Andrew Erie, MD)

Purpose: Identify sonographic abnormalities of the lateral femoral cutaneous nerve (LFCN) in meralgia paresthetica (MP).
Materials and Methods: IRB approved, retrospective chart review was performed on 51 ultrasound reports of the LFCN in patients with clinically suspected MP. Ultrasounds were considered positive for MP if the ultrasound report suggested the diagnosis. A control group included 20 ultrasounds of the LFCN in lower extremities without symptoms of MP.
Results: Of the 51 ultrasounds in clinically suspected MP, 36 (70%) cases had positive findings suggestive of MP, 10 (20%) cases were negative, and in 5 (10%) cases the LFCN was not seen. Sonographic findings in the 36 positive cases included nerve enlargement in all cases (mean area of 0.1 cm^2 +/- 0.01 cm^2 compared to 0.03 cm^2 +/- 0.01 cm^2 in the negative cases and normal controls; $p < 0.01$), nerve hypoechogenicity (30 of 36 cases, 83%), and/or focal injury including neuroma or neuroma-in-continuity (8 of 36 cases, 22%). Sixteen ultrasounds that were positive for MP had MRI imaging of the LFCN, with 4 of the 16 (25%) MRI reports describing a concordant abnormality of the LFCN (nerve enlargement or T2 hyperintensity). The remaining 12 (75%) MRI reports did not describe a LFCN abnormality, however, in retrospect 5 of these cases had subtle MR abnormalities. Twenty-six of the 36 (72%) patients with positive ultrasounds had an US-guided nerve block (local anesthetic +/- corticosteroid) of the LFCN, with 25 of 26 (96%) patients reporting immediate symptom improvement. Eighteen of the 36 (50%) patients with positive ultrasounds underwent neurectomy or neurolysis of the LFCN, with symptom improvement in all cases.
Conclusion: Ultrasound is a useful modality in assessing the LFCN in clinically suspected meralgia paresthetica and is more sensitive for abnormalities than MRI. US-guided nerve block of the LFCN can help further confirm the diagnosis, especially in patients considering surgery.

Podium 28

THERAPEUTIC ARTHROGRAM OF THE HIP FOR ADHESIVE CAPSULITIS: AN INNOVATIVE TREATMENT PROCEDURE THAT REDUCES CAPSULAR STIFFNESS AND INCREASES MUSCLE ACTIVATION

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Purpose: Adhesive capsulitis (AC) is characterized by local joint pain and progressive stiffness, often described as 'frozen shoulder'. AC of the hip (ACH) exhibits similar distinguishing features and clinical presentation. Controversy exists surrounding ACH management, ranging from benign neglect to surgical intervention. Intermediate options are needed for those failing conservative care or reluctant toward surgery. We describe an innovative technique, therapeutic arthrogram (TA), which is a minimally-invasive, radiological intervention involving imaging-guided, intra-articular instillation of fluid and air to release capsular. Chronic capsule contracture influences intra-articular pressure (IAP), which may inhibit surrounding musculature. Releasing adhesions and pressure are hypothesized to reduce stiffness and improve muscle activation.

Materials and Methods: Seven patients (3M/4F) with ACH participated, with an average age, height and body mass of 38.9 ± 11.5 years, 177.4 ± 7.6 cm and 86.0 ± 18.4 kg, respectively. Pain scores (VAS), passive range of motion (pROM) and electromyography (EMG) while performing hip rehabilitation exercises were collected before and after TA procedure. Under fluoroscopic-guidance, a 22-gauge spinal needle was inserted into the hip joint and connected to a pressure sensor. Once needle position was confirmed, sterile saline and air was instilled until capsular disruption occurred. IAP was measured throughout the TA and maximum joint volume recorded.
Results: All patients had confirmed ACH and reduced hip capsular volumes. The procedure was well tolerated with no complications. During TA, IAP values increased linearly, then exponentially up to the maximum capsular volume, which diminished following rupture. Following the TA, increases in pROM were observed, with no significant changes in VAS. Hip EMG increased significantly following the TA procedure.
Conclusion: The TA procedure appears to be a promising, minimally-invasive treatment option for ACH. Our results suggest that joint capsular disruption of adhesions/fibrosis by TA contribute to immediate benefits of reduced capsular stiffness, increased pROM, restoration of IAP and increased muscle activation.

Podium 29

VALUE OF RESPONSE TO ANESTHETIC INJECTION DURING HIP MR ARTHROGRAPHY TO DIFFERENTIATE BETWEEN INTRA- AND EXTRA-ARTICULAR PATHOLOGY

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(Presented by: Miriam Bredella, MD)

Purpose: To determine the value of anesthetic injection during hip MR arthrography (anesthetic MRA) to differentiate between intra- and extra-articular pathology in patients with hip pain.
Materials and Methods: Our retrospective study was IRB-approved and HIPAA-compliant. Sixty-two consecutive patients (38 F, 24 M, 38±13 years) who were referred for MRA were studied. All patients underwent a focused hip examination including active and passive flexion, internal and external rotation immediately prior to injection and pain was recorded on a numeric scale. MRA was performed following fluoroscopically-guided intraarticular injection of 10–12 ml of a mixture of 0.1 ml gadolinium and 10 ml normal saline, 5 ml Isovue-M200 and 5 ml Ropivacaine. Following the injection, the hip examination was repeated and the pain response was recorded. MRA was performed per clinical protocol and reviewed by two musculoskeletal radiologists blinded to the pain response. Clinical records, including physical therapy notes and operative reports were reviewed for verification of intra- and extra-articular pathology as the source of hip pain (gold standard). The positive (PPV) and negative predictive value (NPP) of anesthetic MRA to detect intra- and extra-articular pathology were calculated.
Results: Based on the gold standard, the source of pain was intra-articular in 36 patients and extra-articular in 26 patients. On MRI, 28 patients had only intra-articular and 9 patients only extra-articular pathology, while 25 patients had both intra- and extra-articular pathology. Twenty-nine patients had pain relief and 33 patients had no pain relief after anesthetic injection. PPV of anesthetic MRA to detect intra-articular pathology was 83% and NPV was 64%.
Conclusion: Anesthetic MRA can be used as an adjunct to define the origin of hip pain. A positive response suggests intra-articular pathology which can be helpful to localize the source of pain in equivocal cases where both intra-and extra-articular pathology is evident on MRI.

Podium 30

ABDUCTOR PATHOLOGY IN ISCHIOFEMORAL IMPINGEMENT (IFI)

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(Presented by: Miriam Bredella, MD)

Purpose: Ischiofemoral impingement (IFI) is associated with abnormalities of the quadratus femoris muscle and narrowing of the ischiofemoral (IF) and quadratus femoris (QF) spaces. The hip abductors play important roles in pelvic stability. We hypothesized that abductor insufficiency might be a contributing factor to the development of IFI. The purpose of our study was to assess hip abductor pathology in patients with IFI.

Materials and Methods: The study was IRB approved and HIPAA compliant. The study group comprised 140 patients with IFI (mean age: 56±13 y, 130 f, 10 m) and 140 age and gender-matched controls without IFI. Two MSK radiologists performed measurements of IF and QF distances, assessed quadratus femoris muscle for edema and atrophy, and the integrity of the tensor fascia lata, gluteus medius and minimus tendons. IFI and control groups were compared with a two-tailed t-test or chi-squared test.

Results: As expected, patients with IFI had decreased IF and QF distances (p<0.0001) compared to controls. All patients with IFI had abnormalities of the quadratus femoris muscle, whereas the QF muscle was normal in controls (p<0.0001). Patients with IFI had a higher prevalence of gluteal medius and minmus partial and full-thickness tears compared to controls (p=0.007). There were no tears of the tensor fascia lata in either group. When stratified by age, abductor pathology was only associated with IFI in patients ≥45 years (p=0.001), while there was no difference in prevalence of abductor tears in patients with IFI <45 years (p=0.8) compared to controls.

Conclusion: Abductor insufficiency might play a role in the pathophysiology of IFI in elderly patients. This emphasizes the need of abductor strengthening or repair in the treatment of IFI.

Podium 31

MR APPEARANCE OF ELONGATED GLUTEUS MEDIUS TENDON FOLLOWING TOTAL HIP ARTHROPLASTY

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(Presented by: Dean Busby, MD)

Purpose: To evaluate the MR appearance of the gluteus medius tendon following total hip arthroplasty performed by different surgical techniques.

Materials and Methods: Retrospective records review of MRIs of the pelvis and hips performed following total hip arthroplasty. Review of medical records indicated surgical approach and physical exam findings around the time of imaging. Cases were divided into 2 groups based on whether the surgery was performed by a posterolateral approach or a straight lateral approach. All cases were reviewed in consensus by one attending musculoskeletal radiologist and one MSK fellow to identify cases in which the gluteus medius tendon appeared elongated on coronal images. Original radiology reports were also evaluated.

Results: There were a total of 47 patients with 50 hip arthroplasties. 25 hips had arthroplasty via a straight lateral approach and 25 had a posterolateral surgical approach. 19/25 (76%) of the cases with straight lateral approach had the appearance of an elongated gluteus medius tendon and 3/12 (12%) in the posterolateral approach group had this finding. 4/17 (23%) of the cases with elongated tendons in the straight lateral approach group were described as tears of the tendon in their original reports. There was no indication of tendon dysfunction in follow-up clinical notes.

Conclusion: The appearance of gluteus medius tendon elongation on coronal MR images following total hip arthroplasty is much more common following a straight lateral surgical approach and likely reflects localized muscle injury from surgery rather than a clinically relevant tendon abnormality.

Podium 32

CLINICAL USE OF COMPRESSED SENSING-ACCELERATED SEMAC MRI FOR DIAGNOSING PERIPROSTHETIC ABNORMALITIES IN PATIENTS WITH PAINFUL HIP AND KNEE ARTHROPLASTIES: WHAT ARE WE MISSING?

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(Presented by: Jan Fritz, MD)

Purpose: When compared to parallel imaging (PI), compressed-sensing (CS) allows for 50-60% faster acquisition of slice-encoding-for-metal-artifact-correction (SEMAC). CS-SEMAC produces similar image quality in subjects with well-functioning arthroplasty implants; however, there is limited data on diagnosing abnormalities in patients. Therefore, we compared the performance of standard 3-fold-accelerated PI-SEMAC and investigational 8-fold-accelerated CS-SEMAC MRI for diagnosing periprosthetic abnormalities in patients with painful total hip and knee arthroplasty implants.

Materials and Methods: Our study was IRB-approved and all patients gave written informed consent. Between 2014 and 2017, we prospectively recruited 60 patients with pain and dysfunction after hip (14 women, 16 men; age, 68(44–87) years) and knee (10 women, 20 men; age, 62(28–91) years) arthroplasty. Each patient underwent 1.5-Tesla MRI, including coronal (hip) and sagittal (knee) PI-accelerated (factor=3, 22-min) and CS-accelerated (factor=8, 10-min) PD-weighted and STIR SEMAC with 19 spectral encoding steps. Paired PD-weighted and STIR dataset were separated, image annotations were removed and randomly reassigned. Two MSK attendings evaluated the global image quality and six periprosthetic abnormalities. Wilcoxon test, Kendall W agreement, and substitutability testing were applied. P-values < 0.05 indicated statistical significance.

Results: Image quality of hip and knee studies were overall good with slight non-significant (p=0.12/0.37) dominance of PI-SEMAC over CS-SEMAC. Reader agreements were moderate to very good (W range, 0.51-0.85). Inter-method agreement was overall good (W, 0.67/0.40). For each joint, substitution analysis demonstrated that the faster CS-SEMAC could replace the slower PI-SEMAC technique (p-value range, 0.38-0.90) in diagnosing the six abnormalities, including periprosthetic osteolysis, synovitis, bone marrow edema, fractures, tendon tears, and extra-capsular collections.

Conclusion: In patients with painful hip and knee arthroplasty implants, PI-SEMAC and CS-SEMAC techniques produce similar image quality. The faster acquired CS-SEMAC can substitute the slower PI-SEMAC technique for diagnosing a wide spectrum of periprosthetic abnormalities, thereby realizing single SEMAC sequences with 19 spectral encoding steps in 4-5 min acquisition time.

Podium 33

COMPARISON BETWEEN RADIOGRAPHY AND MAGNETIC RESONANCE IMAGING FOR THE DETECTION OF SACROILIITIS IN THE INITIAL DIAGNOSIS OF AXIAL SPONDYLOARTHRITIS: A COST-EFFECTIVENESS STUDY

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(Presented by: Natalia Gorelik, MD)

Purpose: The purpose of this study was to determine the cost-effectiveness of radiograph and MRI based imaging strategies for the initial diagnosis of sacroiliitis in a population with suspected axial spondyloarthritis.

Materials and Methods: A decision analytic model from the health care system perspective for patients with inflammatory back pain suggestive of axial spondyloarthritis was used to evaluate the incremental cost-effectiveness of 3 imaging strategies for the sacroiliac joints during a 3-year horizon: radiography, MRI, and radiography followed by MRI. Comprehensive literature search and expert opinion provided input data on cost, probability, and utility estimates. The primary effectiveness outcome was quality-adjusted life-years (QALYs), with a willingness-to-pay threshold set to $100,000/QALY gained (2018 U.S. dollars). Costs and health benefits were discounted at 3%.

Results: Radiography was the dominant strategy, as it was the least costly ($64,782) and most effective (2.43 QALYs) option over a 3-year course. MRI-based and radiograph/MRI-based strategies were not found to be cost-effective imaging options for this patient population. One-way sensitivity analysis demonstrated that radiography was favored over the other two imaging strategies over a wide range of reasonable costs and probabilities.

Conclusion: Radiography is the most cost-effective imaging strategy for the initial diagnosis of sacroiliitis in patients with inflammatory back pain suspicious for axial spondyloarthritis.

Podium 34

MINDING THE GAP: VERTEBRAL BODY FRACTURE CLEFTS AND WHAT THEY MEAN FOR POST-VERTEBROPLASTY OUTCOMES

Jesse MK
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(Presented by: MK Jesse, MD)

Purpose: Percutaneous vertebroplasty/kyphoplasty has been documented as a safe and effective treatment for vertebral body fractures. Cement nonunion is a documented cause of failed vertebral cement fixation. We focus on how pre-procedural fracture cleft morphology and procedural cement filling may be associated with the development of non-union and furthermore how this may affect patient outcomes.

Materials and Methods: Retrospective review of 296 patients (172 women, 124 men) who underwent vertebroplasty/kyphoplasty for compression fractures. Variables included pre-procedure CT/MRI cleft presence and morphology, pain improvement, underlying pathology, fracture level, morphology of cement fill, and post-procedure non-union. Statistical analysis was performed utilizing ordinal logistic regression, logistic regression, Fisher's exact, and conditional t-tests of proportions, with significance level set to 0.05.

Results: Majority of patients with nonunion cement fill (75%) demonstrated large cleft morphology. The presence of a fracture cleft resulted in an 4.981 odds ratio of non-union and odds of cleft presence is 5.195 times higher for non-union (95% CI: 1.636, 20.157). There was a significant association between non-union cement fill and cleft-only fill (p<0.0001). Patients with secondary osteoporosis had 2.831 higher odds of cleft (95% CI: 1.119, 7.299). Odds of cleft presence was 1.029 times higher for each one year increase in age (95% CI: 1.119, 7.299). The presence of a vertebral cleft did not significantly alter pain relief outcomes.

Conclusion: Because risk of cement non-union increases with increasing age, secondary osteoporosis, size of the fracture clefts, and cleft-only cement fill, we should pay special attention when these variables are present to adjust our procedure protocol and expectation. The presence of a cleft should not deter the decision to proceed with vertebroplasty/kyphoplasty, as pain relief was not significantly altered; however added attention to increasing trabecular fill during the procedure is warranted to decrease the risk of non-union.

Podium 35

VARIABILITY IN PERCUTANEOUS PROCEDURES FOR VERTEBRAL OSTEOMYELITIS AMONG RADIOLOGISTS

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(Presented by: Claus Simpfendorfer, MD)

Purpose: To poll those radiologists who perform spine biopsies in regards to their decision-making and biopsy technique in attempt to identify and highlight the variability and inconsistencies between practices and individual radiologists.

Materials and Methods: Survey of SSR members who perform spinal procedures.

Results: A total of 88 SSR members responded to the survey. Of the respondents, 45 (51%) worked in an academic/university setting, 35 (40%) were private practice and 8 (9%) in a hybrid practice. The majority of respondents, 68%, were unaware of the 2015 Infectious Diseases Society of America (IDSA) guidelines for the diagnosis and treatment of vertebral osteomyelitis. CT was the preferred modality for image guidance used by 73%. Core biopsy or combination of core biopsy/FNA was performed by 86%, with a combination of the disc and endplate targeted for biopsy by 70%. Pathology specimen sent routinely by 75% of respondents and two or more samples obtained by 73%. Antibiotics are not routinely held by the majority of respondents, 65%, despite recommendation to hold antibiotics in IDSA guidelines. Most respondents will not perform biopsies of the cervical spine or aspirate epidural collections, 75% and 71% respectively. Only 11% of respondents will perform a therapeutic drainage or lavage of a lumbar epidural abscess for persistent bacteremia. Those respondents working in an academic setting were more likely to be aware of the IDSA guidelines and more likely to perform a biopsy in the cervical spine.

Conclusion: There is significant variation among radiologists prior to and during diagnostic biopsies for vertebral osteomyelitis despite the Infectious Diseases Society of America guidelines for the managemtn of vertebral osteomyelitis published in 2015. Additionally, the majority of radiologist will not biopsy the cervical spine in suspected cases of vertebral osteomyelitis or perform a therapeutic aspiration/lavage of a lumbar epidural abscess.

Podium 36

THE ROLE OF SARCOPENIA IN CLINICAL VERTEBRAL AUGMENTATION OUTCOMES

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(Presented by: Amanda Crawford, MD)

Purpose: Age related muscle deterioration (sarcopenia) has been implicated in detrimental changes in spinal biomechanics. With the high prevalence of vertebral body fractures in the elderly, it is important to investigate the role of sarcopenia as it relates to vertebral augmentation outcomes. The purpose of our study is to investigate this association.
Materials and Methods: With IRB approval, this study retrospectively reviews patients who underwent kyphoplasty or vertebroplasty at our institution from 2008 until 2017 for the treatment of thoracic or lumbar vertebral body fractures.
Analysis included assessment of sarcopenia by calculating the total psoas area (TPA) based on CT imaging. This was measured using the cross-sectional area of the psoas muscles at the level of L4. Other variables included: the rate of adjacent level fractures, the difference between pre-procedural and post-procedure pain scores, and the prescription of post-procedural pain medication and muscle relaxants.
Results: Initial exploratory analysis with a sample of 40 patients suggests there is a positive correlation between low pre-procedural sarcopenia values and the rate at which patients suffer an adjacent level fracture following kyphoplasty. Initial evaluation also suggests more reliable improvement in pain scores for patients with TPA in the immediate post-procedural period. Power and statistics to follow with the addition of ~230 more patients to our data set.
Conclusion: Predicting clinical outcomes in the treatment of thoracic and lumbar spinal fractures with vertebral augmention is an important part of treating our growing elderly population. Recognizing patients susceptible to adjacent level fracture not only improves our clinical management but may also influence the need for prophylactic fixation of adjacent levels. Improved prediction of expected pain may also assist in referral to other medical subspecialties including physical therapy and pain management.

Podium 37

IS SPINAL MRI VALUABLE IN ADDITION TO MRI OF THE SACROILIAC JOINTS IN THE DIAGNOSIS OF SPONDYLOARTHRITIS?

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(Presented by: Stuabbs Euan, MBChB)

Purpose: To determine if MRI of the entire spine offers additive value to MRI of the sacroiliac joints in the imaging evaluation of patients referred with suspected spondyloarthritis.
Materials and Methods: Retrospective study of 119 consecutive patients, over a 24 week period referred by rheumatologists for MRI evaluation for spondyloarthritis (SpA). All patients underwent MRI of the entire spine and sacroiliac joints. MRI examinations were separated into 'spine' and 'sacroiliac joint' components and were evaluated separately and as a combined set 2 months apart.Two staff radiologist readers were asked to answer the question 'Does the patient have spondyloarthritis?' and record their level of certainty in the diagnosis on a 5-point Likert scale. Differences in reader certainty in the diagnosis of SPA for spine, sacroiliac joints and combined evaluations were calculated using McNemar's test. Using final diagnosis by the rheumatologists as the gold standard, sensitivities and specificities for the diagnosis of SPA on MRI for each read, and absolute differences in sensitivity and specificity between evaluations were calculated.
Results: The addition of MRI of the spine to MRI of the SIJs did not significantly improve radiologist certainty for the diagnosis of SpA (147/268 for combined read compared with 163/268 for SIJ read- p value of 0.07). Sensitivity and specificity for the diagnosis of SpA from combined read versus SIJ read demonstrated no absolute difference (p 0.07 to 1.0 and p 0.17-0.79 respectively).
Conclusion: MRI of the SIJs alone may be as effective as the combination of MRI SIJs and Spine in the diagnosis of SpA. MRI of the spine provided no significant benefit in reader certainty or diagnostic accuracy for the diagnosis of SpA.

Podium 38

THE ROLE OF PARASPINAL EDEMA IN CLINICAL VERTEBRAL AUGMENTATION OUTCOMES

Durst M, Jesse MK, Crawford A, Ho C, Bhaumik D
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(Presented by: Michael Durst, MD)

Purpose: With high prevalence of vertebral body fractures in a growing elderly population, it is important to investigate pre-operative factors affecting surgical outcomes of vertebral augmentation. The presence and degree of severity of paraspinal edema varies on preoperative MRIs obtained in surgical candidates for spinal fracture fixation. The purpose of our study is to investigate associations between pre-procedural paraspinal edema and reported pain scores in the post-procedural period.
Materials and Methods: With IRB approval, this study retrospectively reviews patients who underwent kyphoplasty or vertebroplasty at our institution from 2008 until 2017 for the treatment of thoracolumbar vertebral body fractures.
Paraspinal edema on MRI was scored by a musculoskeletal radiologist. Each patient was assigned an edema score from "0-3" based on an internally set standard. Variables included the patients' pain scores, obtained pre-procedure, immediately post-procedure, at post-procedural day 1, and in the following weeks (when available).
Results: Initial exploratory analysis suggests positive correlation between pre-procedural paraspinal edema and higher pre-procedural pain scores. Regardless of edema, patients report similar immediate post-procedural pain scores. On post-procedural day 1, the cohort with more paraspinous edema demonstrated a rebound increase in pain higher than their lower edema counterparts; while those with lower edema scores continued to improve. Pre-procedural, immediate post-procedural, and post-procedural day 1 scores averaged 7.1/10, 4.0/10, and 3.7/10 respectively in the lower edema group, while higher edema groups reported an average of 8.6/10, 3.8/10, and 6.4/10, respectively. Power and statistics to follow with addition of ~230 patients to our data set.
Conclusion: Predicting clinical outcomes in the treatment of thoracic and lumbar spinal fractures with vertebral augmentation is an important part of treating our growing elderly population. Improved diagnostic radiologic detection of factors predicting pain and peri-procedural course will improve our clinical management and help set realistic expectations for our patients.

Podium 39

TRANSPEDICULAR-TRANSDISCAL CEMENT AUGMENTATION TECHNIQUE FOR TREATMENT OF PROXIMAL JUNCTIONAL FAILURE OF SPINAL FUSION

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(Presented by: Corey Ho, MD)

Purpose: Spinal deformity often requires long instrumented fusion constructs for treatment. However, complications occur, including development of fracture and kyphosis at the junctional level between the fused and mobile spine. Proximal junction kyphosis (PJK), defined as a Cobb angle change >10-degrees from pre-operative measurement, has an incidence as high as 40%. Symptomatic PJK often requires revision surgery and hardware extension. Vertebral cement augmentation (VCA) can be performed prophylactically to prevent proximal junctional level failure but is not always performed. We report a single center experience using a novel percutaneous transdiscal technique to stabilize the proximal instrumentation and adjacent level in an attempt to treat hardware failure and avoid revision surgery.

Materials and Methods: Retrospective review of VCA was performed with selection of cases using transpedicular-transdiscal fluoroscopic technique to treat symptomatic proximal junctional failure. Worsening sagittal imbalance as well as fractures of the upper instrumented and proximal non-instrumented vertebrae were present. VCA of the proximal instrumented and adjacent level was performed using a percutaneous transdiscal approach. Pre- and post-procedure pain levels and sagittal balance measurements were obtained.

Results: 6 patients (2 women, 4 men), with average age of 71 years (range 58-82), underwent transpedicular-transdiscal VCA varying from the T3-T11 levels. Average pre-procedural pain was 7.2 out of 10 (range 0-10) with average pre-procedural sagittal imbalance of 9.1 cm (range 6.4-11.5). Average post-procedural pain level was 2.7 out of 10 (range 0-6) with average post-procedural sagittal imbalance of 7.7 cm (range 5.4-13.0). None of the patients experienced an increase in pain. All but one patient demonstrated a decrease in sagittal imbalance following the procedure. Revision surgery was not required for any case with average follow-up time of 14.6 months (range 8-21).

Conclusion: VCA can be performed utilizing transpedicular-transdiscal approach to treat proximal junctional level failure to provide stabilization, pain relief, and possible avoidance of revision surgery.

Podium 40

MIDLINE INTERLAMINAR LUMBAR EPIDURAL INJECTIONS: INSTITUTIONAL EXPERIENCE SAFELY UTILIZING DEPO-MEDROL®

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(Presented by: Daniel Carr, MD)

Purpose: Epidural steroid injection is a common procedure for treatment of low back pain with radiculopathy. Depo-Medrol® (Pfizer, methylprednisolone acetate), one formulation of particulate steroid, has come under scrutiny in the press, questioning its safety. Although catastrophic complications have been associated with paraspinal injection of particulate steroid, our data shows the formulation is safe when used via the midline interlaminar approach for lumbar epidural injections. We report our experience with this approach using Depo-Medrol with the aim of evaluating its safety.

Materials and Methods: We retrospectively reviewed fluoroscopically guided interlaminar epidural lumbar spine injections at our institution. In just the last 10 years, 13,955 fluoroscopically guided, interlaminar lumber epidural injections with Depo-Medrol were performed. Fluoroscopic images, reports, and patient records were reviewed for any significant related complications.

Results: Over 10 years, 13,955 patients underwent fluoroscopically guided interlaminar epidural steroid injection with Depo-Medrol. No documented significant complications related to particulate steroid administration were identified.

Conclusion: Fluoroscopically guided lumbar spine epidural Depo-Medrol® injection is a safe procedure when utilizing the interlaminar approach.

Podium 41

FLUOROSCOPICALLY-GUIDED LUMBAR SPINE INTERLAMINAR AND TRANSFORAMINAL INJECTIONS: INCIDENCE AND LOCATION OF INADVERTENT INTRAVASCULAR INJECTION

Chang C, Husseini J
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(Presented by: Connie Chang, MD)

Purpose: To prospectively evaluate the incidence of inadvertent intravascular injection for fluroscopically guided lumbar injections.

Materials and Methods: Our study was IRB-approved and HIPAA-compliant. 77 patients who presented for lumbar injection were prospectively enrolled. All injections were performed with fluoroscopic guidance using a 22 gauge spinal needle by either interlaminar or transforaminal approach. A minimum of 1 mL of iodinated contrast was injected under 15 frame/second live fluoroscopy to evaluate for intravascular flow. Patient demographics, history of surgery at the injected level or an adjacent lumbar level, injection side, site, and approach, and volume of contrast injected when blood vessels became visible were recorded. Chi-square comparison was performed to compare patient surgery and inadvertent intravascular injection.

Results: The patient cohort was 95 ± 14 (16-88) years old with 41 (53%) males and 36 (47%) females. There were 32 (42%) interlaminar and 45 (58%) transforaminal; 38 (52%) left and 39 (48%) right; 2 (3%) L1-L2, 9 (12%) L2-L3; 14 (14%) L3-L4; 26 (34%) L4-L5, 8 (10%) L5-S1, and 8 (10%) S1-S2 injections. For 17 (22%) patients, there had been surgery at the injected or adjacent lumbar level. There were 8 (10%) inadvertent intravascular injections, 1 (13%) interlaminar and 7 (87%) transforaminal. The blood vessels were visualized after 0.3 ± 0.2 (0.1-1) mL contrast was injected (the 1 mL was the interlaminar injection). A higher percentage of patients with inadvertent intravascular injection (6/8, 75%) had surgery at the injected level or an adjacent level, compared with patients without inadvertent intravascular injection (11/69, 16%) (P = 0.0001).

Conclusion: Inadvertent intravascular injection occurred in 10% of our lumbar injection cohort, and may be more common with transforaminal injection and at a level at or adjacent or prior surgery. Injection of adequate contrast volume and knowledge of vascular contrast patterns are important to avoid complications for lumbar injections.

Podium 42

CHARACTERIZATION OF INDETERMINATE LIPOMATOUS TUMORS: WHAT IS THE ADDED VALUE OF ADVANCED MRI SEQUENCES?

Ahlawat S, Shannon B, Levin A, Morris C, Fayad L
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(Presented by: Shivani Ahlawat, MD)

Purpose: To evaluate the added value of dynamic contrast enhancement(DCE), diffusion weighted imaging(DWI), and chemical shift imaging(CSI) to a routine MRI protocol for the characterization of indeterminate lipomatous tumors.
Materials and Methods: In this HIPAA compliant, IRB approved study, two musculoskeletal radiologists retrospectively reviewed pre-procedure MRI of 32 histologically proven indeterminate lipomatous tumors. MRI included fluid-sensitive, CSI, DWI (b-values 50, 400, 800 s/mm^2), pre- and post-contrast T1-weighted and DCE (7-second time resolution) sequences. MRI studies were reviewed for tumor septations, nodules, early arterial enhancement by DCE, apparent diffusion coefficient (ADC) values of the tumor and largest nodule, and CSI signal-loss on opposed-phase compared with in-phase sequences. Radiologist diagnosis (lipoma, lipoma variant, atypical lipomatous tumors(ALT) or dedifferentiated liposarcomas(DDLPS)) was recorded after review of imaging in 3 sessions: 1) T1/fluid-sensitive sequences, 2) with addition of post-contrast T1, and 3) with addition of DCE, DWI and CSI sequences. Histology was the diagnostic gold standard. Descriptive statistics and diagnostic accuracy were reported.
Results: All tumors without thick septations were lipomas, and 12/13 tumors with nodules >1cm were ALT or DDLPS. For lipomas, variants, ALT, and DDLPS, respectively: early arterial enhancement was present in 0/14(0%), 1/4(25%), 1/5 20%), and 5/6(83%); average tumor ADC values were 0.3, 0.9, 1.2, and 0.9; CSI signal loss >20% was present in 4/13(31%), 3/4(75%), 6/7(86%), and 6/6(100%). The radiologist's interpretation accuracy using pre-contrast, post-contrast, and functional/CSI sequences, respectively, was 6/6(100%), 6/6(100%) and 6/6(100%) for lipomas; 0/2(0%), 0/1(0%), and 0/2(0%) for lipoma variants; 5/15(33%), 5/16(32%), and 5/15(33%) for ALT; and 5/9(56%), 5/9(56%), and 5/9(56%) for DDLPS.
Conclusion: Diagnostic interpretation for indeterminate lipomatous tumors is not changed by the addition of contrast or functional imaging with DCE or DWI, as thick septations and large nodules are important to differentiating low grade (lipoma/variants) from higher grade lesions (ALT/DDLPS). However, DCE has the potential to distinguish DDLPS from ALT.

Podium 43

IMAGING FEATURES OF LIPOMATOUS TUMORS ON 18F-FDG PET/CT

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(Presented by: Francis Baffour, MD)

Purpose: To evaluate the ^{18}F-FDG PET/CT characteristics of benign and malignant lipomatous tumors.
Materials and Methods: Patients undergoing ^{18}F-FDG PET/CT from 01/2005 to 03/2018 with pathologically-confirmed lipomatous tumors were retrospectively reviewed. 13 lipomas, 5 hibernomas, 16 well-differentiated liposarcomas (WDL), 16 dedifferentiated liposarcomas (DDL), 15 mxyoid liposarcomas (ML), and 2 pleomorphic liposarcomas (PL) were included, and multiple imaging features were analyzed.
Results: There were 67 patients (44M, 23F; mean age 58.8±13.6 years). Mean SUVmax of lipomas was 0.8 ± 0.2, WDL 2.3 ± 1.2, ML 3.0 ± 1.0, hibernomas 11.9 ± 8.4, PL 13.5 ± 2.9, and DDL 16.3 ± 11.4. SUVmax was not significantly different between lipomas and WDL (p = 0.52), lipomas and ML (p = 0.35), or WDL and ML (p = 0.75). SUVmax was also similar between hibernomas and DDL (p = 0.16), hibernomas and PL (p = 0.76), and DDL and PL (p = 0.53). Overall, SUVmax was not significantly different between benign (3.9 ± 6.5) and malignant (7.6 ±9.2) tumors, p = 0.13, but high-grade liposarcomas were more hyper-metabolic than low grade liposarcomas (SUVmax 12.8 ± 10.8 vs. 2.5 ±1.2, p = 0.0001). Hibernomas and WDL had similar CT attenuation (-60.9 ± 21.0 vs. -49.3 ±37.9 HU, p=0.31), but hibernomas had higher SUVmax (11.9 ± 8.4 vs. 2.3 ± 1.2, p = 0.0033). 10/13 (76.9%) lipomas were superficially located, while 47/54 (87.0%) of other subtypes were deep (p < 0.0001). DDL were significantly larger than hibernomas (p = 0.026) and lipomas (p = 0.005); otherwise there were no significant volume differences.
Conclusion: There is no significant difference in metabolic activity between benign and malignant lipomatous tumors, but FDG PET/CT can differentiate between high and low-grade liposarcomas. In some cases, a combination of metabolic activity and CT morphology can distinguish between lipomatous tumor subtypes.

Podium 44

ROUND CELL COMPONENTS OF MYXOID LIPOSARCOMA: CAN WE IDENTIFY THESE CONCERNING AREAS ON IMAGING?

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(Presented by: Mark Murphey, MD)

Purpose: To determine whether pathologically confirmed round cell components of myxoid liposarcoma representing higher grade regions can be detected on imaging.
Materials and Methods: We retrospectively reviewed 22 pathologically confirmed cases of myxoid liposarcoma with round cell components. Studies were reviewed by three musculoskeletal radiologists with agreement by consensus and included radiographs (n=11), CT (n=9), and MRI (n=20). Evaluation included patient history, demographics, lesion size, location, character of intralesional fat, and intrinsic characteristics on CT and MRI. Higher grade round cell components were seen as foci of higher attenuation or mildly high T1 or low T2 signal or focal enhancement.
Results: Average patient age was 51 years, with male predominance (59%). Symptoms included swelling, enlarging mass (100%), and pain (9%). Most commonly tumors were Intermuscular (59%), found in the thigh (75%). The average lesion measured 7.8 x 8.7 x 14.6 cm. Radiographs demonstrate soft tissue mass or fullness (91%). On CT, all tumors were well defined, containing fat (89%), although less than 10% fat by volume (100%). On MRI, all tumors were well defined and the majority were heterogeneously hypo- or isointense to muscle (88%) on T1 weighted imaging. Tumors demonstrated heterogeneously high or intermediate (83%) T2 signal. Hemorrhage was identified in 12%, and fat in 70% of tumors (70%), most commonly less than 10% of neoplasm volume (92%). Areas suggesting round cell components were seen on CT in 11% of cases and MR in 55% of cases.
Conclusion: A significant round cell component within myxoid liposarcoma, representing high grade foci, may commonly be identified on MR (55%). These are seen as foci of increased T1 or decreased T2 signal, or diffuse focal enhancement relative to the myxoid regions of the lesion. These components are important to detect and target at biopsy as they are associated with worsened prognosis and may alter therapy.

Podium 45

ADVANCED MR IMAGING OF BONE MARROW: QUANTIFICATION OF T1-WEIGHTED AND T2-WEIGHTED DIXON SIGNAL ALTERATIONS OF RED MARROW, YELLOW MARROW AND PATHOLOGICAL BENIGN AND MALIGNANT MARROW LESIONS.

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(Presented by: Oganes Ashikyan, MD)

Purpose: T2-weighted (W) Dixon imaging is being frequently used in musculoskeletal MRI. Despite the advantages of T2W Dixon in producing both fat- and fat-suppressed contrasts, the changes in signal intensity of yellow marrow, red marrow, benign and malignant lesions have not been characterized and it is not known whether the T2W Dixon imaging performs like T1W chemical shift imaging (current gold standard) in separating reactive marrow from lesions.
Materials and Methods: Patient demographics and final diagnoses were recorded (77 controls, 64 lesions—33 benign, 31 malignant). For controls, fixed 2 cm^2 ROI were drawn by two readers independently at L5 vertebra, bilateral ilium and femurs on in-phase and out-of-phase T1W and T2W Dixon images. For lesions, best fit ROI were drawn. Fat fractions on T2W Dixon images were calculated and compared. Inter-reader analysis was performed and decision model was generated.
Results: Yellow marrow exhibited significantly lower fat fraction loss as compared to red marrow on T1W and T2W Dixon imaging at all locations ($p < 0.0001$ except at L5 on T2W Dixon ($p = 0.206$). Both benign and malignant lesions showed lower fat fractions as compared to both yellow ($p = 0.0087$, $p < 0.0001$) and red marrow ($p = 0.0004$, $p < 0.0001$) on T2W Dixon imaging. Malignant lesions showed lower fat fraction as compared to the benign lesions on T2W Dixon imaging ($p = 0.0005$). Signal intensity loss on red and yellow marrow were lower on T1W Dixon as compared to T2W Dixon (0.49-0.64, 0.27-0.31 vs 0.70-0.74, 0.48-0.71). Inter-reader agreements were excellent (0.91-0.97).
Conclusion: T2W Dixon imaging signal intensity changes can sufficiently differentiate between yellow marrow, red marrow, benign and malignant bone marrow lesions. Along with its ability to provide four comprehensive maps—in-phase, out-of-phase, water and fat only images—T2W Dixon imaging can be an important singular imaging modality in bone marrow characterization and bony lesion identification.

Podium 46

MUSCULOSKELETAL (MSK) UTILIZATION AND PERFORMANCE OF WHOLE-BODY MRI (WBMRI) IN THE ADULT POPULATION

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(Presented by: Jacob Feldhaus, MD)

Purpose: To evaluate MSK practice patterns of WBMRI in the adult population across multiple institutions in an effort to better understand current clinical practice utilization and understand the need for best practice and/or dedicated WBMRI Current Procedural Terminology (CPT) code development.
Materials and Methods: A 12-question survey was created in Survey Monkey®. The survey was distributed to the SSR

membership by email on September 19, 2018. The survey included demographic questions and questions regarding the use of whole body MRI in the adult population, such as specific scanning parameters, indications for WBMRI, and details related to billing/coding.
Results: 89 of 1454 (6%) SSR members responded to the survey. 29% of physicians completing the survey stated that they routinely performed WBMRI. The most common indication for performing WBMRI at these institutions was multiple myeloma (82%) followed by tumor staging (30%), assessing response to therapy (30%), and evaluation of cancer predisposing syndromes (30%). The most commonly utilized MRI sequences were coronal short tau inversion recovery (STIR) (82%) and coronal T1 without fat saturation (74%). No other single sequence was performed by greater than 40% of respondents. No preference was shown for either 1.5-T or 3-T magnetic field strengths. There was variability for billing code utilization with 24% of respondents using the bone marrow MRI code and 18% the unlisted MRI procedure code (24% did not know).
Conclusion: WBMRI is currently being utilized at a significant minority of institutions for evaluation of metastatic disease and various systemic disease processes in adult patients. There is considerable variation in usage, imaging technique, and billing code selection among radiology practices based on our survey results. Therefore, further investigation regarding WBMRI best practice and dedicated CPT code development may be warranted.

Podium 47

OSTEOID OSTEOMAS OF THE HIP: A WELL-RECOGNIZED ENTITY WITH A PROCLIVITY FOR MISDIAGNOSIS

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(Presented by: Doris Wenger, MD)

Purpose: Despite their small size and well-documented clinical and radiographic features, the diagnosis of osteoid osteomas about the hip can be challenging with potential for delayed or inaccurate diagnosis. Presenting symptoms and imaging features can mimic FAI, stress fracture and tumor. The goals of our study were to 1) assess the most common misdiagnoses and treatments, 2) define the mean delay in diagnosis, 3) describe the imaging features and 4) provide tips for avoiding diagnostic imaging pitfalls.
Materials and Methods: We identified 26 patients (27 tumors) with OO of the femoral neck (n=25) and acetabulum (n=2) referred for ablation between 1998 and 2017. There were 14M/12FM; mean age 19 years. 26 of 27 patients were referred after initial evaluation and/or treatment elsewhere. Imaging studies included radiographs (n= 24), CT (n=27) and MRI (n=22).
Results: The most common initial diagnoses were stress fracture (n = 8), FAI (n = 4), malignant tumor or infection (n = 4). 3 patients were initially diagnosed as having OO. Prior interventions included ORIF for femoral neck stress fracture (n = 2), hip arthroscopy and PAO (n = 1), synovectomy (n = 1), and attempted RFA (n = 1). Mean time from symptom onset to diagnosis of OO was 15 months (range, 0.4 – 84). All MRI exams showed bone marrow edema (BME) in the femur (n=20) or acetabulum (n=2), which was attributed to other pathology for 20 of 22 MRI exams. The OO was evident on all CT exams and in retrospect on 14 of 22 MRIs.
Conclusion: 75% of OO were initially misdiagnosed in our series. This led to delay in diagnosis for the majority and unnecessary intervention in 15%. Consideration of OO in the differential diagnosis of hip pain in young patients and familiarity with the imaging features is essential for making an accurate and timely diagnosis.

Podium 48

DESMOPLASTIC FIBROBLASTOMA: AN UNCOMMON SOFT TISSUE TUMOR WITH A RELATIVELY CHARACTERISTIC MR IMAGING APPEARANCE

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(Presented by: Maxine Kresse, MD)

Purpose: We describe the MR, CT, US and radiographic imaging features of desmoplastic fibroblastoma.
Materials and Methods: We retrospectively reviewed the imaging features of 20 pathologically confirmed cases identified in our institutional pathology database.
Results: The 20 patients consisted of 12 woman (60%) and 8 men (40%) ranging from 20 to 96 years of age (average 59 years, 5 months). Lesions were relatively small ranging from 1 to 11 cm (average 4.4 cm) and most commonly ovoid and/or lobulated in shape. History was available in 19 cases identifying a slowly growing mass in 11cases (58%), two becoming painful over time, with the remaining 8 cases (42%) being incidental findings. Most lesions were deep (85%) with only 3 (15%) being superficial. Deep lesions were most often intermuscular (9; 53%), followed by intramuscular (5: 29%) and juxta-articular (3: 18%.). MR imaging was available for 18 cases (15 with/without contrast), CT in 10 case, ultrasound in 12, radiographs in 11, and PET/CT in one. Lesion margins were well-defined in all cases typically demonstrating varying amount of very low (dark) and intermediate signal, similar to that of tendon and skeletal muscle respectively. On fluid sensitive sequences, lesions showed greater heterogeneity with generally more prominent decreased (dark) signal and variable intermediate signal similar to and greater than that of skeletal muscle. Contrast enhancement was characteristically peripheral and septal with varying areas of homogeneous enhancement. Nonconrast CT showed attenuation similar to that of skeletal muscle in all cases except one which was mildly heterogeneous. Ultrasound typically showed a mixed echogenic mass while radiographs were negative or demonstrated a nonmineralized mass with one case showing osseous remodeling.
Conclusion: The MR imaging features of desmoplastic fibroma are most characteristic demonstrating a relatively small, well-defined mass, with low and intermediate signal with the low signal intensity becoming more pronounced with increased T2-weighting.

Podium 49

RADIOMIC FEATURES EXTRACTED FROM T1 MRI DISTINGUISH MYXOMAS FROM MYXOFIBROSARCOMAS BETTER THAN IMAGE INTENSITY

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(Presented by: Ronnie Sebro, MD)

Purpose: Myxoid tumors pose great diagnostic challenges for radiologists. Myxomas are benign pauci-cellular, bland myxoid tumors which do not metastasize, but can recur. Myxofibrosarcomas are malignant myxoid tumors that are histologically heterogenous and have the propensity to metastasize. We hypothesized that T1 MRI could help distinguish myxomas from myxofibrosarcomas. We evaluated the performance of image intensity information, tumor volume, and radiomic features extracted from T1 MRI to distinguish myxomas from myxofibrosarcomas.
Materials and Methods: T1 MRI dataset of 56 patients, consisting of 29 patients with myxoma and 27 patients with myxofibrosarcomas was analyzed. We identified a solid tumor region, and a reference region to normalize image intensity values across subjects. A total of 89 radiomic features were also extracted from the dataset. Random forests based classifiers were built upon the radiomic features for distinguishing myxoma from myxofibrosarcomas. Performance of the classifiers built upon radiomic features was compared with those built using image intensity and volume features. The number of trees and the minimum leaf size of the random forests classifiers were set to 500 and 3, respectively. The classifiers were validated using a leave-one-out cross-validation. Classification accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC) were used to evaluate the classification performance.
Results: Myxoma tumors had lower normalized T1 signal intensity values than myxofibrosaromas (p=0.006) and AUC was 0.713. The classification model built upon radiomic features obtained an AUC of 0.885 (accuracy=0.839, sensitivity=0.852, specificity=0.828), and outperformed the classification models built upon image intensity and tumor volume features (AUC=0.838). The classifier built upon the image intensity values had worse classification performance than the classifier built upon the radiomic features (p=0.039, DeLong test).
Conclusion: The results that radiomic features could provide more discriminative information for distinguishing myxoma from myxofibrosarcoma tumors compared to volume-based measures and T1 image intensity values.

Podium 50

"POSSIBLE" MENISCAL TEARS AT KNEE MRI: REVISITING THE SINGLE-TOUCH RULE

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(Presented by: Lindsay Stratchko, DO)

Purpose: To determine the positive predictive (PPV) value of a "possible" meniscus tear according to the single-touch rule using arthroscopy as the reference standard.
Materials and Methods: A retrospective review was performed to identify all knee MRI exams with reports containing the terms "possible" or "probable meniscus tear" from March 2006 to August 2018. Patients with a history of prior meniscus surgery, meniscal root abnormality, absence of knee arthroscopy, or knee arthroscopy performed more than four months after the MRI exam were excluded. Two musculoskeletal radiologists independently reviewed all MRI exams blinded to the arthroscopy findings. Only cases with agreement of both radiologists for a "possible" meniscus tear, defined as signal abnormality extending to an articular surface on only a single image slice, were included in the analysis. PPVs were calculated using arthroscopy as the reference standard based on demographics, history of knee injury, presence of anterior cruciate ligament (ACL) injury, scanner type, location of meniscus tear, and presence of radiographic knee osteoarthritis (OA) and were compared using Fischer's exact tests.
Results: 136 MRI exams met the inclusion criteria and had a "possible" meniscus tear according to the single-touch rule confirmed independently by two radiologists. The overall PPV of a "possible" meniscus tear was 33.9% with PPVs for the medial and lateral meniscus of 29.8% and 36.7% respectively. The PPVs for subjects with age of 40 years and younger and age older than 40 years were 27.5% and 40.3% respectively. The PPV for subjects with and without ACL injury were 40.0% and 30.2% respectively. The PPV for subjects with and without knee OA was 40.8% and 32.5% respectively. However, the differences failed to reach statistical significance.
Conclusion: The PPV of a "possible" meniscus tear according to the single-touch rule was only 33.9%.

Podium 51

COMPARING CLINICAL AND SEMI-QUANTITATIVE CARTILAGE GRADING IN PREDICTING OUTCOMES AFTER ARTHROSCOPIC PARTIAL MENISCECTOMY

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(Presented by: Naveen Subhas, MD, MPH)

Purpose: Preoperative cartilage loss is a predictor of poor outcomes after arthroscopic partial meniscectomy (APM). Previous studies have used time-intensive MRI grading systems, such as MOAKS (MRI OsteoArthritis Knee Score), which are not amenable for routine clinical use. This study's purpose was to test whether cartilage loss graded using MOAKS provides better prediction of outcomes than a simpler clinically used grading system.
Materials and Methods: 80 cases were selected meeting the following criteria: 1. Preoperative knee MRI performed within 6 months of APM surgery 2. Outcomes measured at the time of surgery and 1 year after surgery. Surgical failure was defined as a less than 10 point improvement in the Knee Osteoarthritis Pain Score (KOOS$_{pain}$). Cases were independently evaluated by 2 musculoskeletal (MSK) radiologists and 1 radiology fellow using MOAKS and a modified Outerbridge grading system used clinically. Accuracy of each system in discriminating success and failure was estimated using area under the ROC (AUC) with 95% confidence intervals (CI).
Results: 78 patients (38 females) with mean age of 56.6 years (range of 45-77) were studied. 32 patients (41%) were surgical failures. At least Grade 2 (< 50% cartilage thickness loss) ranged from 8% (lateral tibial plateau) to 26% (medial femoral condyle) of the observations. AUC values of the clinical grading system (range 0.585 – 0.625) were very similar to MOAKS (range 0.553 to 0.667) for all cartilage surfaces and non-inferior to MOAKS in the medial femoral condyle (p = 0.015) and trochlea (p =0.031). The lateral femoral condyle was the only surface where MOAKS (0.667) was significantly higher than the clinical grading system (0.614).
Conclusion: Cartilage loss graded using MOAKS and a simpler clinically used system have similar ability in predicting outcomes after APM. This suggests that it is feasible to use routine clinical grading of cartilage to develop models to predict outcomes after APM.

Podium 52

DOWNSTREAM COSTS ASSOCIATED WITH INCIDENTAL CARTILAGE LESIONS DETECTED ON RADIOGRAPHS

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(Presented by: Paul-Michel Dossous, MD)

Purpose: To explore variation in downstream costs associated with cartilage lesions incidentally detected on radiographs.
Materials and Methods: The cohort was composed of 120 patients with incidental, not previously diagnosed, cartilage lesions seen on appendicular plain radiographs. The population was divided into three subgroups based on the interpreting radiologist's description: enchondroma, low-grade cartilage lesion, and chondrosarcoma. Downstream events (follow-up imaging, office visits, biopsy, tumor resection) associated with the lesions were identified from the electronic medical record. American College of Radiology (ACR) Appropriateness Criteria were used to classify radiologists' recommendations. National Medicare rates were used to estimate costs of downstream events. Average cost per lesion was stratified, and cost ratios were computed among subgroups.
Results: Average downstream cost per lesion was $75.56. Costs were 4.6 times greater in patients under the age of 65 than over. Costs were 13.2 and 13.7 times higher when radiologists characterized lesions as chondrosarcoma versus low-grade cartilage lesion and enchondroma, respectively. There was no statistically significant difference in costs between the subgroups when accounting for size and location of lesions. Compared to when follow-up imaging was neither recommended nor obtained, costs rose from $0 to $26.03 per patient when follow-up imaging was recommended and obtained, and $62.21 per patient when follow-up imaging was obtained despite not being recommended. Costs rose from $0 to $14.83 per patient when radiologists' recommendations for follow-up were adherent to the ACR guidelines for management of incidental bone lesions. Costs were 2.3 times greater when ordering physicians overmanaged compared with radiologists' recommendations. No malignancy was pathologically proven in the cohort.
Conclusion: Costs for incidental cartilage lesions vary. Size and location of lesions do not have a significant effect on downstream costs; however, radiologists' characterization and recommendation have an impact. Therefore, it is imperative that radiologists accurately characterize such lesions and recommendations reflect the best value for patient care.

Podium 53

CAN PREOPERATIVE MR IMAGING FINDINGS PREDICT EARLY FAILURE FOLLOWING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION?

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(Presented by: Jenny Bencardino, MD)

Purpose: The aim of this study is to identify markers of early failure of anterior cruciate ligament graft reconstruction (ACLR) based on preoperative MR imaging.
Materials and Methods: We identified 26 patients with early ACLR graft failure (<2 years) who underwent revision between 2011-2015 in a retrospective review of our database. Exclusion criteria included graft choice other than autografts (n=4) and non available preoperative MRI (n=3). Nineteen patients with early ACLR failure were included in the study group. The control group consisted of 38 subjects who underwent ACLR with a minimum of 2 years of clinical follow up and no evidence of graft failure matched by age, sex, BMI and graft type. Preoperative MRI obtained within 8 weeks (range 1-8) following initial trauma were reviewed blinded to the ACLR failure by an experienced (20 years) musculoskeletal radiologist for intra and periarticular lesions including: anterolateral ligament (ALL) injuries (stretch, partial, complete), medial meniscus tear (MM), lateral meniscus tear (LM) tear, posteromedial corner injury (PMC), posterolateral corner injury (PLC) injury, medial collateral ligament tear (MCL), and lateral collateral ligament tear (LCL). Logistic regression analysis was performed.
Results: Mean time to ACLR failure was 14 months (range, 1-24 months). Mean follow up of those in the control group was 38 months (range, 2561). Medial meniscus (MM) tear was the best predictor of early ACLR failure (Accuracy=66.7%, p=0.08) followed by the lateral meniscus (p=0.13). MM was a significant predictor of ACLR failure (p=0.02) with odds ratio (OR) 4.2 and 95% confidence interval (CI) [1.19 14.9]. All other variables were not associated with ACLR failure (p>0.20).
Conclusion: MM tears were the best predictor of early failure of ACLR. Thus, preserving the integrity of the MM during ACLR procedure may be crucial in minimizing the risk for early ACLR failure.

Podium 54

RUPTURE OF THE ANTEROLATERAL LIGAMENT IN COMPLETE ACUTE TRAUMATIC ANTERIOR CRUCIATE LIGAMENT TEAR: NEW INSIGHTS INTO ACUTE PIVOT SHIFT TRAUMA TO THE KNEE.

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(Presented by: Jenny Bencardino, MD)

Purpose: To evaluate the prevalence and association of anterolateral ligament (ALL) rupture with other meniscal and ligamentous injuries of the knee in patients with complete acute traumatic anterior cruciate ligament (ACL) tear.
Materials and Methods: Based on retrospective review of our orthopedic surgery database, 57 patients M45:F12, mean age 21 (range:13-34) with acute post traumatic ACL rupture who underwent ACLR seen between 2011 and 2015 were enrolled in this cohort. Preoperative MR examinations was performed by an experienced (20 years) MSK radiologist assessing these variables: anterolateral ligament (ALL) rupture, MM tear, LM tear tear, posteromedial corner injury (PMC), posterolateral corner injury (PLC) injury, MCL tear, and lateral collateral ligament tear (LCL). Odds ratios and their 95% confidence interval were used to assess the associations of ALL with other injuries in the knee. To rule out confounding factors we used the Cochran Mantel Haenszel method in an analysis stratified by gender and BMI (normal, overweight).
Results: Most commonly reported lesions were of the MM 63%, and PLC 64%. ALL partial or complete tears and Segond avulsion fracture were reported in 28 patients (49%). Anterolateral lesions were associated with a 10 fold decreased risk of MM tear (odds ratio [OR] = 0.10, 95% [CI]=[0.028, 0.38]) and a 4.6 fold increased risk of LCL tear (OR=4.68, 95% CI=[1.28 17.1]). Neither gender nor BMI were confounding for the associations of ALL with MM and LCL tears. No other statistically significant associations between ALL rupture and LM, PMC, PLC and MCL injury were found.
Conclusion: Failure of the ALL during acute traumatic ACL rupture is often associated with tear of the LCL. This may have a protective effect over the MM due to potential "capsular release" ewith increased mobility of the MM and decreased risk of clipping/tearing between the approximating medial compartment surfaces during pivot shift trauma.

Podium 55

ULTRASOUND SHEAR WAVE ELASTOGRAPHY (SWE) OF THE TIBIALIS POSTERIOR TENDON (PTT) AND TIBIOSPRING/SPRING LIGAMENTS AT REST AND STRESS IN NORMAL FEET COMPARED TO ASYMPTOMATIC AND SYMPTOMATIC ACQUIRED FLATFOOT DEFORMITY

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(Presented by: Mihra Taljanovic, MD, PhD)

Purpose: The PTT and spring ligament stabilize the medial longitudinal foot arch and are affected in adult acquired flatfoot deformity (AAFD). This study measured ultrasound (US) shear wave velocities (SWV) of the PTT and tibiospring/spring ligaments in individuals with a normal arch and in those with asymptomatic and symptomatic AAFD to assess differences in SWE velocity values.

Materials and Methods: Two observers performed SWE of the PTT in the long and short axes in two anatomic locations and along the tibiospring/spring ligaments at rest in 8 normal feet, 5 asymptomatic and 7 symptomatic flatfeet. The second observer repeated measurements in the PTT long axis in the upper location and in tibiospring/spring at stress. The study was performed on a Siemens S3000 unit with a 9-MHz linear transducer. Each measurement was repeated three times. The values at rest and stress at each location were compared with paired t-tests. ANOVAs were used to test SWV differences at rest and stress between the three groups.
Results: There was high interreader agreement (ICC = 0.9134, 95% CI = 0.8769 – 0.9391), thus scores from both readers were averaged. There was a significant difference (F = 31.51, p < 0.0001), with post hoc Protected Least Squares Difference test showing lower SWV of the short PPT axes compared to long. Lower SWVs were found in the PTT and ligaments in the symptomatic flatfeet, compared with normal in each location. Higher SWVs were found along the PTT in the lower long axis location in the asymptomatic flatfeet compared with other two groups. None reached significance although SWV in the spring ligament and PTT lower long axis at rest approached significance. There was a significant difference for PTT upper long axis at stress.
Conclusion: SWE may be a useful adjunct in evaluation and management of patients with AAFD.

Podium 56

REDUCTION OF UNNECESSARY REPEAT KNEE RADIOGRAPHS DURING OSTEOARTHRITIS FOLLOW UP VISITS IN A LARGE TEACHING MEDICAL CENTER.

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(Presented by: Oganes Ashikyan, MD)

Purpose: The purpose of our project was to determine the baseline frequency of unnecessary knee radiographs obtained for evaluation of severe osteoarthritis. We also determined whether clinician education can reduce the frequency of unnecessary radiographs.
Materials and Methods: Radiology reports of knee radiographs were searched in our database filtered for presence of word "severe" anywhere within the report. The resulting database was further filtered based on presence of any of the following terms: "degenerative", "osteoarthritis", "DJD", "joint space", "compartment", and "narrowing." Consecutive 500 reports and corresponding medical records were reviewed to confirm presence of severe osteoarthritis and presence or absence of repeat radiograph. The indication for repeat radiograph was determined. Repeat radiographs were counted as "non-indicated" when provided history and review of corresponding clinic visit note revealed no new symptoms or new suspected injuries. Educational PowerPoint presentation was distributed to all faculty, fellows, and residents in orthopedic and family practice departments via email in May 2018. The radiology reports database was again searched for knee radiographs obtained from June 2018 to August 2018. Rate of repeat radiographs was again calculated.
Results: Initial search returned 1517 reports. Further filtering of the reports returned 1227 reports. There were 112 repeat radiographs (22.4%) within 6 months in a subsample of manually reviewed 500 radiograph reports. 77 (69%) knee radiographs of 112 were classified as "not indicated." Repeat search of radiology reports after the educational intervention was performed after the initial three months follow up period. Only two repeat radiographs were found in the follow up sample. One of this was not indicated. The second was obtained to evaluate new injury. (Longer follow up data will become available prior to the meeting and results based on additional data will be presented.)

Conclusion: Simple clinician educational intervention results in significant reduction of number of unnecessary repeat knee radiographs.

Podium 57

LATERAL FEMORAL CONDYLE INSUFFICIENCY FRACTURES: ASSOCIATED MORPHOLOGICAL FINDINGS

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(Presented by: Adam Zoga, MD)

Purpose: Medial femoral condyle insufficiency fractures (MFCIF) are strongly associated with medical meniscal tears and medial compartment high-grade chondrosis. We hypothesise that lateral femoral condyle insufficiency fractures (LFCIF) are less frequently associated with meniscal tears and high-grade chondrosis in the lateral compartment. The purpose of this study is to evaluate the MRI characteristics of LFCIF and their associated morphological findings.

Materials and Methods: A retrospective review of consecutive patients with LFCIF was performed after excluding post-traumatic fractures and other pathological subchondral fractures (e.g. underlying bone lesions).

Data collection is in progress and at the time of submission 59 consecutive patients with LFCIF were included (age range 17-86 years, median 57 years). Morphological findings including lesion size and location, presence of bone marrow and soft tissue edema, chondrosis grade and associated meniscal pathology were classified by two board-certified musculoskeletal radiologists and a fellow.

Results: 32 male (54.2%) and 27 female (45.8%) patients were included. Central weight bearing (49.2%, 29/59) and posterior (47.5%, 28/59) locations for LFCIF were most prevalent. The majority of patients had an associated meniscal tear/s (55.9%, 33/59) with medial meniscus tears (42.4%, 25/59) more prevalent than lateral meniscus tears (27.1%, 16/59). High grade chondrosis (grade 3/4) was present in 62.7% (37/59) of patients. Overlying lateral compartment high grade chondrosis was present in 27.1% of patients (16/59) with patellofemoral (42.4%, 25/59) and medial (35.6%, 21/59) compartment high grade chondrosis more prevalent. Bone marrow edema was present in all cases (59/59) and soft tissue edema was present in 83.1% (49/59). Anecdotally 4 subjects with LFCIF previously had a MFCIF at MRI.

Conclusion: LFCIF are less strongly associated with meniscal tears and high grade chondrosis than MFCIF, and unlike MFCIF, more commonly involve the unfractured (medial) compartment than the fractured (lateral) compartment. Patients with LFCIF are in a similar demographic subset to those with MFCIF.