Peri-articular Fat Pads: An Adjunctive Tool in the Diagnosis of Occult Injury

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
The Purpose of this exhibit is: 1. To review location and anatomy of common peri-articular fat pads and their normal appearance 2. To recognize abnormalities in fat pads when occult soft-tissue or bony injury is present 3. To explain the utility of fat pads in the diagnosis of occult injury and correlate plain film findings with MRI
A Radiological Overview of Knee Arthroplasty. Practical Keys in the Assessment of Knee Replacement

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
-To know the different types of knee replacement.
-To review the role of imaging techniques (plain radiograph, CT, MR, US, scintigraphy) in the evaluation of prostheses.
-To understand usefulness and limitations of plain radiographs in the evaluation of knee replacements, emphasizing useful parameters and illustrating image analysis and interpretation.
-To become familiar with normal and abnormal postoperative imaging findings and signs of complications.

TABLE OF CONTENTS/OUTLINE
We review imaging of knee replacement, highlighting key concepts perceived as important variables by the surgeon and correlating images with clinical considerations and functional outcomes. We present:
1. A review of types of replacement: total knee (TKR) and unicompartmental knee replacement (UKR).
3. Imaging. Plain radiographs:-Technique and views. Standard image acquisition: beam and anatomical landmarks-Parameters that should be evaluated: alignment of femoral and tibial components, position (flexion/extension), rotation, patellar assessment, joint line height. -Imaging of complications: infection, polyethylene wear, aseptic loosening, osteolysis, periprosthetic and component fracture.
Participants
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TEACHING POINTS
1. As bone lesions are commonly encountered on CT, having a systematic approach to assessment helps to accurately describe lesions, create relevant differential diagnosis and guide management.
2. Based on CT appearance, bone lesions can be categorized as aggressive and non-aggressive.
3. Radiologists should be aware of benign entities with aggressive features and malignant tumors that may appear non-aggressive.
4. Certain features (such as lesion matrix, multiplicity, location) allow to narrow differential diagnosis.

TABLE OF CONTENTS/OUTLINE
• Outline/Background/Role of CT
• Lesion Features (Location, Density, Matrix, Periosteal/Cortical reaction, Multiplicity)
• Aggressive vs. Non-aggressive features
• Sample cases of benign and malignant lesions
Angiosarcoma of the Musculoskeletal System: Imaging Features and Pathology Correlation

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
1. Angiosarcoma is a rare aggressive neoplasm with a poor prognosis which can involve the skin, multiple soft tissue, and osseous structures. Angiosarcoma has a reported association with multiple infantile hemangiomas and is prone to local recurrence and common metastases.  
2. MRI is valuable for not only defining the extent of disease (which can be multifocal), but also for characterizing the aggressive and vascular nature of angiosarcomas, which typically appear as masses with heterogeneous signal intensity, serpentine vessels, and avid early arterial enhancement on dynamic MR angiography sequences.

TABLE OF CONTENTS/OUTLINE
1. Clinical Presentation
2. Imaging features of angiosarcoma, with a focus on MRI Noncontrast imaging features Dynamic and static post-contrast imaging characteristics
3. Pathology: Gross and microscopic features of angiosarcoma
4. Treatment options and post-treatment imaging.
Recent Advances in Spinal Cord MRI: How Should the Radiologist Use Conventional and Recent MRI Techniques for Diagnosing Spinal Cord Lesions?

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
Spinal cord MRI involves 2-dimensional (2D)/3-dimensional (3D) T1-, T2-, and T2*-weighted sequences, diffusion-weighted imaging (DWI), time-resolved gadolinium-enhanced 3D MRA, fat-water imaging, and phase-contrast cine MRI. Radiologists must know the specificity of each MRI technique and choose the best imaging approach for each patient. We demonstrate the usefulness of each imaging technique in spinal infarct, tumors, arteriovenous malformation (AVM), cystic lesions, and demyelinating diseases.

TABLE OF CONTENTS/OUTLINE
A. Representative cases (useful MRI techniques) Infarct, malignant lymphoma, active multiple sclerosis (DWI) Hemangioma, hemorrhage (T2*-WI, DWI) AVM (gadolinium-enhanced 3D fatsat T1-gradient recalled echo, TRICKS MRA) Syringomyelia, cystic tumors, congenital cysts (SSFSE, 3-point Dixon, balanced SSFP, phase-contrast cine MRI) Compressive myelomalacia (3D T2-acquisition) Lipoma (chemical shift, CHESS, 3-point Dixon) Astrocytoma, ependymoma, metastasis, demyelinating diseases, hereditary Alexander's disease (high-contrast conventional T1-WI, T2-WI, and gadolinium-enhanced MRI)B. Tips and pitfalls in diagnosing spinal cord lesions by using recent MRI techniquesC. Technical considerations for demonstrating spinal AVM: TRICKS MRA and 3D fatsat T1-gradient recalled echo by slow injection of contrast material
Participants
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TEACHING POINTS
The purpose of this exhibit is to review the spectrum of post-operative complications encountered following lower extremity amputations in soldiers and marines suffering blast injuries. Through pictorial review, the exhibit will illustrate the imaging findings associated with these complications, allowing early-identification and treatment. The learner will gain an understanding of the unique features and challenges associated with combat-related trauma and how imaging may help guide therapy.

TABLE OF CONTENTS/OUTLINE
The intent of this exhibit it to provide a review of the imaging findings of post-operative complications following combat-related extremity amputations based on over ten years of institutional experience in caring for wounded warriors. The case-based format includes discussion of: Heterotopic ossification and suboptimal osseous angulation Osseous and soft tissue infections, with emphasis on unique pathogens encountered in the combat-setting Inflammation and fluid collections and their clinical significance Neuroma development following nerve injury Clinical and imaging considerations related to retained foreign bodies
The Usefulness of Ultrasound Imaging in Subungual Glomus Tumors with MRI Correlation

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
- Glomus tumours are rare vascular tumors arising subungually in fingernails, which derive from the glomus body, that contributes to thermoregulation. - The clinical presentation is classic triad of paroxysmal pain, pinpoint pain and cold hypersensitivity. There may be a purplish discoloration under the nail and nail plates deformity. - Its diagnosis was previously based on history and physical examination alone. - Recent years have witnessed an increase in the use of ultrasound imaging of the skin in the field of dermatology, including in inflammatory diseases, tumors and even esthetics. - The purpose is to illustrate the importance of imaging studies in glomus tumour diagnosis, especially of ultrasound with color Doppler imaging, with clinical and MRI correlation.

TABLE OF CONTENTS/OUTLINE
1- To review the main clinical and radiological features of glomus tumor, with special focus on ultrasound and magnetic resonance imaging. 2- To describe the anatomic and technical specificities in nail ultrasound. 3- To demonstrate the usefulness of ultrasound as a simple, quick and noninvasive study to identify and characterize the exact location of the lesion for surgical removal. 4- To demonstrate the ability of ultrasound in the detection of small tumors and recurrence cases, reflecting its effectiveness in the early diagnosis.
Chronic Recurrent Multifocal Osteomyelitis: The Role of Whole-Body MRI in Evaluation and Diagnosis

All Day Location: MK Community, Learning Center

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TEACHING POINTS
- Chronic recurrent multifocal osteomyelitis (CRMO) represents a rare condition characterized by chronic multiple aseptic inflammatory lesions of bone in children and adolescents. - The diagnosis of CRMO is a diagnosis of exclusion. The clinical, radiologic and pathologic findings are non-specific and the recognition of this entity is often delayed with several unnecessary procedures. - It comprises an insidious onset of pain and soft-tissue swelling, with periodic remissions. Systemic manifestations are unusual and laboratory tests are unremarkable. - Tissue cultures in biopsy specimens are negative for infectious agents, but usually show different stages of subacute and chronic inflammation. - Whole-body MRI is useful for the radiation-free detection of occult sites of disease in CRMO. - Familiarity with CRMO is indispensable in differential diagnosis with other bone diseases, including those suggestive of malignancy.

TABLE OF CONTENTS/OUTLINE
1- To review the main clinical, radiologic and histopathologic features of CRMO.
2- To illustrate with conventional MRI different presentations forms of CRMO.
3- To illustrate differential diagnosis simulating CRMO.
4- To emphasize the importance of Whole-body MRI in the diagnosis of CRMO by its ability to access multifocality, allowing early management.
Assessment Bone Lesions in POEMS Syndrome

All Day Location: MK Community, Learning Center

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TEACHING POINTS
- The purpose is to recognize different patterns of bone lesions in POEMS syndrome using computed tomography.
- POEMS syndrome is a rare paraneoplastic disorder characterized by plasma-cell dyscrasia with Polyneuropathy, organomegaly, endocrinopathy, M-protein and skin changes.
- The pathogenesis is yet poorly understood.
- Bone lesions occur in 95% of patients with POEMS and more than 50% are multiple.
- The majority of bone lesions occur in the spine and pelvis.
- Most are well-defined or fluffy sclerotic lesion and others are lytic lesion with peripheral sclerosis.
- Bony excrescences are particularly prominent in the posterior elements of the spine and at tendinous and ligamentous insertion sites, and are virtually pathognomonic for POEMS syndrome.
- CT is particularly sensitive to find bone lesions, allowing early diagnosis and specific therapy, improving survival and life quality of such patients.

TABLE OF CONTENTS/OUTLINE
1- To review the major and minor criteria for the diagnosis of POEMS syndrome.
2- To describe and illustrate the main radiological features of bone involvement in POEMS syndrome.
3- To discuss the differential diagnosis for this entity (including sclerotic lesions and osseous proliferation in the spine).
4- To demonstrate the usefulness of bone findings in treatment strategies.
Myxofibrosarcoma - A Tail Not to be Missed

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
Purpose
Outline the pathology of myxofibrosarcoma (MFS) Demonstrate the MRI appearances of MFS - Illustrate the unusual tail-like growth pattern of MFS - Emphasize the importance of determining the full extent of local tumor spread in planning surgical resection
Review differential diagnoses of other tumors that can have a similar appearance

TABLE OF CONTENTS/OUTLINE
1. Pathology of MFS
2. Imaging appearance at MRI
   Primary tumor Location: subcutaneous or deep location in the extremities
   High T2 signal on MRI due to myxoid content
   Nodular mass-like or superficial spreading growth pattern
   Tapering “tails” of enhancement extending along fascial planes
   Metastases: lung and atypical locations (pleura, adrenal glands, mesentery, bone)
3. Sample cases
4. Differential diagnoses, including other myxoid tumors
   Intramuscular myxoma
   Benign peripheral nerve sheath tumor
   Undifferentiated pleomorphic sarcoma
   Myxoid liposarcoma
   Extraskeletal myxoid chondrosarcoma
Conclusion
Myxofibrosarcoma has an extensively infiltrative growth pattern, which often manifests as “tails” of enhancement extending from the main mass. Determining the full extent of the tumor, including its infiltrative margins, on MRI is critical in preoperative planning to ensure complete resection, and thus minimize the risk of local recurrence.
Imaging of Posterior Tibial Function and Dysfunction: A Multimodality Approach

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
The major teaching points of this exhibit are:- Knowledge of the spectrum of Posterior Tibial Dysfunction (PTD), focusing on the main plantar arch stabilizer, the Posterior Tibial Tendon (PTT), and its relationship/link/connection with other anatomic structures, as the talo-navicular ligament (spring ligament), or the sinus tarsi, among others.-Study the normal anatomy and function of this biomechanical complex, with drawing schemes.-Recognize the radiological signst that are useful in its correct evaluation, enfatizing on MRI and US.-Learn the main treatment options, conservative or surgical.

TABLE OF CONTENTS/OUTLINE
1- Introduction to Posterior Tibial Dysfunction (PTD) 2- Anatomy and biomechanics of the plantar arch and the Posterior Tibial Tendon 3- Clinical presentation of PTD 4- Radiological assessment of PTD: plain radiograph, ultrasonography and MRI 5- Treatment options 6- Conclusions
TEACHING POINTS
- Ultrasound (US) is an effective, accessible, and inexpensive modality that can be used with a high degree of diagnostic confidence to evaluate common shoulder pathologies.
- Review standard shoulder US technique, common shoulder pathologies, and differential diagnosis based on patient history and presentation.
- Identify characteristic imaging features (US with MRI correlation) of common shoulder pathologies.

TABLE OF CONTENTS/OUTLINE
- Introduction and overview of shoulder US including technique and normal US imaging appearance.
- Summary: Familiarity with the US appearance of common shoulder pathologies aids in establishing a specific diagnosis or limiting differential diagnosis.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Scott Sheehan, MD - 2014 Honored Educator
Jeffrey J. Peterson, MD - 2012 Honored Educator
Hypertrophic Osteoarthropathy (HOA) - What Lies Beneath Hippocrates' Fingers

All Day Location: MK Community, Learning Center

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TEACHING POINTS
The purpose of this exhibit is to educate the radiologist about the pathogenesis, classification, imaging features, and differential diagnosis of hypertrophic osteoarthropathy (HOA), as well as its potential association with pulmonary and non-pulmonary conditions. The reader will be given a series of imaging-based cases demonstrating key findings in hypertrophic osteoarthropathy using various imaging modalities. A discussion of other causes of multifocal periostitis, differentiating features, and imaging examples will also be provided.

TABLE OF CONTENTS/OUTLINE
Etiology and pathogenesis of HOA
Classification of HOA (primary or pachydermoperiostosis vs. secondary HOA)
Signs and symptoms of HOA including painful clubbing of the digits
Imaging features of HOA (radiography, CT, MR, and nuclear medicine)
Radiological imaging cases of HOA and pulmonary vs non-pulmonary causes
Differential diagnosis of HOA including thyroid acropachy, chronic venous insufficiency, and voriconazole-induced periostitis
Clinical significance and prognosis of HOA

References
Musculoskeletal Applications of Spectral CT: Principles, Physics and Clinical Applications

All Day Location: MK Community, Learning Center

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TEACHING POINTS
Dual energy/spectral CT scanners can provide material characterization capabilities of different tissues. There are several implementations of dual energy CT, including a recently introduced dual-layer technology. There are several areas of application in musculoskeletal imaging.

TABLE OF CONTENTS/OUTLINE
- Dual energy CT: Physics and principles
- Implementations of dual energy CT: Dual source, rapid kV switching, dual spin dual layer, photon counting
- Advantages and disadvantages
- Types of spectral images
- Phantom studies
- Musculoskeletal applications of spectral CT with illustrations
  - Gout: Identification of monosodium urate crystals; diagnosis; monitoring therapeutic response
  - Artifact reduction: Metal, beam hardening
  - Visualizing tendons
  - Visualizing ligaments
  - Identify bone marrow edema
  - CT arthrography: Low dose, detection of meniscal and labral tears
  - Rotator cuff tears
  - Calcium pyrophosphate dehydrate, calcium hyroxyapatite disease
  - Iron deposition in pigmented villonodular synovitis

Honored Educators
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Prabhakar Rajiah, MD, FRCR - 2014 Honored Educator
Jacob Sosna, MD - 2012 Honored Educator
Jason DiPoce, MD - 2013 Honored Educator
Training Camp 101: An Interactive Resident Tutorial on Sports-Related Injuries Seen on MRI during an NFL Training Camp and Season

All Day Location: MK Community, Learning Center

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TEACHING POINTS


TABLE OF CONTENTS/OUTLINE

Imaging of Patellar Maltracking: An Update

All Day Location: MK Community, Learning Center

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TEACHING POINTS
1. To provide an overview of the biomechanics of patellar maltracking (PM).
2. To discuss the cross-sectional imaging features of the various PM indicators.
3. To identify the structural changes that can be seen in the patellofemoral joint in association with PM disorder.

TABLE OF CONTENTS/OUTLINE
Biomechanics of PM
Imaging evaluation of PM
PM indicators: Patella alta, trochlear dysplasia, lateralization of the tibial tuberosity, lateral patellar tilt and patellar lateralization
PM and Hoffa's fat pad impingement
PM and early patellofemoral articular cartilage damage: Review of the current evidence
Conclusion
MRI is a vital tool in evaluating the causes of anterior knee pain, including patellar maltracking, due to the complexity of the structure and biomechanics of the patellofemoral joint. Early recognition of the morphologic features associated with patellar maltracking disorder can have a significant impact in developing treatment strategies that may potentially prevent the progression or the development of early articular cartilage damage.
Evidence-based Levels, Guidelines and Recommendations in Interventional Spine Treatments According to Clinical Diagnoses

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
This evidence-based spine pain presentation aims at: 1. understanding management algorithms based on clinical symptoms, 2. learning the levels of evidence, guidelines and recommendations of diagnostic and therapeutic interventions, 3. including existing controversies in the decision making process of specific treatments.

TABLE OF CONTENTS/OUTLINE
Femoroacetabular and Other Atypical Forms of Hip Impingement: New Concepts and Spectrum of Imaging Findings

All Day Location: MK Community, Learning Center

Participants
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Miguel Grande, MD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1. To describe hip anatomy and radiological measurements pertinent to hip impingement syndromes. 2. To discuss the role of imaging in the evaluation of femoroacetabular and other atypical forms of hip impingement (including ischiofemoral, anterior inferior iliac spine/subspine and iliopsoas impingement), doing a review of current concepts. 3. To illustrate the main radiologic features of different forms of hip impingement with the use of case examples.

TABLE OF CONTENTS/OUTLINE
1. Background
2. Diagnostic imaging considerations concerning hip impingement syndromes - hip anatomy - basic and advance hip imaging techniques (X-ray, CT, MRI, MR arthrography) - radiographic measurements
3. Hip impingement forms
   3.1 Femoroacetabular impingement
      - clinical presentation - diagnosis and imaging findings
         a) cam form
         b) pincer form - treatment
   3.2 Extra-articular forms of hip impingement
      a) Ischiofemoral impingement - clinical presentation - diagnosis and imaging findings - treatment
      b) Anterior inferior iliac spine or subspine impingement - clinical presentation - diagnosis and imaging findings - treatment
      c) Iliopsoas impingement - clinical presentation - diagnosis and imaging findings - treatment
4. Take home messages
It's Complicated...When Fractures Don't Unite

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
1. To review fundamental concepts of fracture and bone healing physiology. 2. To define and exemplify the spectrum of fracture healing complications, emphasizing nonunion and infection. 3. To discuss special imaging considerations for postoperative fracture evaluation.

TABLE OF CONTENTS/OUTLINE
I. Fracture Background
   A. Initial principles of fracture treatment
   B. Fracture healing physiology and chronology
      1. Primary bone healing
      2. Secondary bone healing
      II. Diagnosis and Management of Poor Bone Healing
         A. Nonunion
            1. Definitions and diagnostic criteria
            2. Causes and types
            3. Treatment
         B. Osteomyelitis
            1. Diagnosis
            2. Orthopedic treatment principles
      III. Postoperative Imaging Considerations
         A. CT
         B. MRI
         C. Nuclear Medicine
What’s in a Name? Eponymous Conditions and Anatomic Structures of the Musculoskeletal System

All Day Location: MK Community, Learning Center

Participants
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TEACHING POINTS
Musculoskeletal radiology is replete with the names of individuals who have contributed greatly to not only orthopedics and musculoskeletal imaging, but also to society as a whole. The purpose of this exhibit is as follows:1. To provide a list of anatomic structures and conditions which have been named after such individuals.2. To review relevant clinical information regarding these anatomic structures and conditions.3. To discuss the lives and contributions of the individuals these structures and conditions were named after.

TABLE OF CONTENTS/OUTLINE

1. Review musculoskeletal structures named after historic individuals, as well as discussing their locations and functions. These include Lister's tubercle, the Stieda process, the Lisfranc ligament, the ligament of Struthers, and Gerdy's tubercle.2. Review pathologic processes named after historic individuals, discussing pathophysiology, physical manifestations and radiologic findings. These include Colles fracture, Pellegrini-Stieda disease, Osgood-Schlatter's, Sindig-Larsen-Johannson syndrome, Freiberg's infraction, and Bankart and Hill-Sachs lesions.3. Discuss the historic figures these diseases and structures were named after, including where they were from and educated, the reasons these structures and diseases bear their names, and additional interesting facts.
TEACHING POINTS
1. Understand the MRI appearance of the major soft tissue and osseous structures of the thumb, with an emphasis on the first CMC and MCP joints.
2. Learn about normal variations in the appearance of these structures on MRI.
3. Appreciate how these structures are different in the thumb than in the other fingers.

TABLE OF CONTENTS/OUTLINE
Thumb muscles and tendons at the level of the wrist
- Extensors
  - Abductor pollicis longus tendon and extensor pollicis brevis in compartment 1
  - Extensor pollicis longus in compartment 3
- Thenar musculature
  - Opponens pollicis
  - Flexor pollicis brevis
  - Abductor pollicis brevis
- Adductor pollicis
- Carpal tunnel
- Flexor pollicis longus (FPL)
- Dorsal and volar ligaments of the first carpometacarpal (CMC) joint
- Sesamoids, volar plate, and dorsal plate with emphasis on the first metacarpophalangeal (MCP) joint
- Radial collateral ligament (RCL) and ulnar collateral ligament (UCL) proper and accessory with emphasis on the first MCP joint
- Extensor tendons and extensor mechanism
  - FPL and thumb pulley system
- Thumb abductors

Honored Educators
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Jeffrey J. Peterson, MD - 2012 Honored Educator
Beyond the Greater Trochanter: The Many Bursa about the Pelvis

All Day Location: MK Community, Learning Center

Participants
Stephen A. Currie, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Travis J. Hillen, MD, Saint Louis, MO (Abstract Co-Author) Consultant, Biomedical Systems; Instructor, DFine, Inc
Jeremiah R. Long, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
James D. Stensby, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Qi Xiao, St Louis, MO (Abstract Co-Author) Nothing to Disclose
Michael V. Friedman, MD, Saint Louis, MO (Presenter) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is to: Illustrate examples of the most common and lesser-known bursa located throughout the pelvis Review pertinent osseous and musculotendinous anatomy specific to each bursa location Review and illustrate common causes of bursitis including overuse, trauma, and infection Highlight differentiating radiologic features to aid in diagnosis

TABLE OF CONTENTS/OUTLINE
Pathophysiology of bursitisReview imaging findings and differentiating radiologic features to aid in the diagnosis of bursitisReview and provide case examples of the many bursa located throughout the pelvis More common: Subgluteus maximus (Greater trochanteric), Iliopsoas, Ischial Less common: Obturator Internus, Ischiogluteal, Ischiofemoral, Subgluteus medius/minimus Discuss pertinent osseous and musculotendinous anatomy specific to each locationDiscuss current treatment options
Ultrasound and Magnetic Resonance Imaging of Soft Tissue Masses of the Ankle and Foot: What the Clinician Needs to Know

All Day Location: MK Community, Learning Center

Participants
Elena Ocon, MD, PhD, Madrid, Spain (Presenter) Nothing to Disclose
Karla H. Vivancos Costaleite, MD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Luz Parra Gordo, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Alfonso Ascension Diaz, Madrid, Spain (Abstract Co-Author) Nothing to Disclose
Nieves Gomez Leon, MD, Madrid, Spain (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
To illustrate the imaging spectrum of benign and malignant soft tissue masses of the foot and ankle and its differential diagnosis To determine key features in Ultrasound (US), Doppler US and Magnetic Resonance (MR) to establish the nature and extent of lesions and their relationship to anatomic boundaries and vital structures

TABLE OF CONTENTS/OUTLINE
Our aim is to show the anatomical distribution and imaging features of benign and malignant soft tissue masses of the ankle and foot and to evaluate the efficacy of US, Doppler US and MR in the diagnosis and management of these lesions. We show key findings at each modality with emphasis on potential pitfalls, diagnostic difficulties and differential diagnosis. We compare with the underlying pathologic features when available. Specific topics addressed include: Morton’s neuroma, ganglion cyst, lipoma, vascular lesions, fibromatoses, neuromatoid nodule, pigmented villonodular synovitis/giant cell tumor of tendon sheath, peripheral nerve sheath tumours [PNSTs], synovial sarcoma, liposarcoma, extraskeletal Ewing sarcoma (PNET) and soft tissue chondromyxoid fibroma.
MRI of Acute Groin Muscle Injuries in Soccer and Concomitant Pathology
All Day Location: MK Community, Learning Center

Participants
Daichi Hayashi, MBBS, PhD, Bridgeport, CT (Presenter) Nothing to Disclose
Ali Guermazi, MD, PhD, Boston, MA (Abstract Co-Author) President, Boston Imaging Core Lab, LLC; Research Consultant, Merck KgaA; Research Consultant, Sanofi-Aventis Group; Research Consultant, TissueGene, Inc
Andreas Serner, MD, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Per Holmich, MD, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Adam Weir, MD, Doha, Qatar (Abstract Co-Author) Nothing to Disclose
Frank W. Roemer, MD, Boston, MA (Abstract Co-Author) Chief Medical Officer, Boston Imaging Core Lab LLC Research Director, Boston Imaging Core Lab LLC Shareholder, Boston Imaging Core Lab LLC

TEACHING POINTS
- To describe the epidemiology of acute groin muscle injuries in athletes
- To illustrate types and mechanisms of acute groin injuries sustained by soccer players
- To review the anatomical descriptions of injury including grading and concomitant pre-existing findings

TABLE OF CONTENTS/OUTLINE
Groin injuries are common in soccer. It is a complex topic in regard to diagnosis and therapy. There is little epidemiological data on groin injuries in professional football. Imaging plays an increasingly important role in the evaluation of acute groin injuries. Our exhibit includes:
1. Overview of published epidemiology of groin muscle injuries
2. Pictorial review of acute muscle injuries sustained by soccer players, including illustration and specifics for each pathology and explanation of injury mechanisms - Adductor longus, brevis and pectineus strains - Rectus femoris - Iliopsoas - Rectus abdominis - Other such as gracilis, obturator internus and externus and tensor fasciae lata - Concomitant findings such as perisymphysial bone marrow edema, secondary cleft sign, labral tears and cysts
3. Role of MRI grading, differentiation of acute vs. chronic muscle injury, central tendon involvement and detailed description for treatment decisions
4. Role of other imaging modalities such as ultrasound and CT

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Ali Guermazi, MD, PhD - 2012 Honored Educator
MK131-ED-X

Radiologic Grading of Gas in the Musculoskeletal System : From Incidental to Critical Gas

All Day Location: MK Community, Learning Center

FDA Discussions may include off-label uses.

Participants
Hye Yeon Oh, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Sung Hwan Hong, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ja-Young Choi, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Hye Jin Yoo, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hee-Dong Chae, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The purpose of this exhibit is :1. To review etiology of gas in the musculoskeletal system 2. To suggest imaging grading of musculoskeletal gas on the importance of the meaning 3. To discuss differential diagnosis of musculoskeletal gas

TABLE OF CONTENTS/OUTLINE
• Etiology of gas in the musculoskeletal system- physiological, degenerative, necrotic, traumatic, infectious and iatrogenic gas• Imaging grading of musculoskeletal gas- trivial gas: intradiscal/intraarticular vacuum and procedure-related gas- notable gas: Kummell's disease and posttraumatic gas- critical gas: emphysematous spondylitis/osteomyelitis and necrotizing soft tissue infection• Differential diagnosis of musculoskeletal gas• Confusing gas and mimickers The major teaching points of this exhibit are:1. Gas in the musculoskeletal system varies with different types of etiology 2. Radiologic classification of musculoskeletal gas can be made based on clinical significance 3. The presence of gas in the musculoskeletal system can either exclude or suggest infectious condition. Extensive gas within bone, joint or soft tissue is more likely indicative of musculoskeletal infection.
Posterior Root Meniscal Tears: Preoperative, Intraoperative, and Posteroperative Imaging for Transtibial Pullout Repair

All Day Location: MK Community, Learning Center

Participants
Ron R. Winters, MD, MBA, Houston, TX (Presenter) Nothing to Disclose
Theodore B. Shybut, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Marc H. Willis, DO, Houston, TX (Abstract Co-Author) Nothing to Disclose
Collin D. Bray, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Andrew R. Palisch, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
• Discuss clinical implications of posterior root meniscal tears leading to osteoarthritis
• Examine recent radiologic and orthopedic classification of meniscal root tears
• Review preoperative imaging and what the surgeon wants to know for transtibial pullout repair
• Identify postoperative imaging appearance of transtibial pullout repair

TABLE OF CONTENTS/OUTLINE
• Introduction Anatomy of posterior meniscal root
• Physiology of meniscus and hoop strength
• Root tears lead to meniscal extrusion and altered biomechanics resulting in osteoarthritis
• Recent classification of posterior root tears
• Radiologic classification by MRI
• Orthopedic classification by arthroscopic morphology
• Preoperative imaging of meniscal root tear and what the surgeon wants to know
• Radiographic evaluation for osteoarthritis and Kellgren-Lawrence grading
• MRI evaluation of root tear including type and location, extrusion, and cartilage grading
• Transtibial pullout repair
• Recent technique to repair root tears to maintain meniscal anatomy and physiology
• Intraoperative images and video of repair
• Postoperative imaging of posterior root tear with transtibial pullout repair
• Radiographic appearance of transtibial tunnel and cortical button
• MRI evaluation of root tear repair, extrusion, and cartilage grading
• Conclusion and References
Walking the "TightRope": Complications of the Mini TightRope Procedure for Correcting Hallux Valgus Deformity

All Day Location: MK Community, Learning Center

Participants
James C. Haug, DO, Converse, TX (Presenter) Nothing to Disclose
Liem T. Mansfield, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Mini TightRope procedure is an osteotomy-sparing alternative to correcting hallux valgus deformity. Understanding the anatomy, key steps of the technique, and biomechanics of the foot helps the radiologist become more aware of the common potential surgical complications. Evaluation of intermetatarsal distance and hallux valgus angle are key components that help radiologists detect subtle cases of hardware complications.

TABLE OF CONTENTS/OUTLINE
Arthritis in Blue and Green: Clinical Application of Dual Energy CT (DECT) in Patients with Suspected Crystalline Arthropathy

All Day Location: MK Community, Learning Center

Participants
Michael D. Berven, MD, Fort Sam Houston, TX (Presenter) Nothing to Disclose
Liem T. Mansfield, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Dual energy CT has been shown to be an accurate method of differentiating monosodium urate crystals in gout from calcium pyrophosphate deposition of pseudogout frequently seen within the joints and soft tissues. Differentiating urate from calcium is accomplished by scanning an area using two different CT x-ray tubes in the same gantry simultaneously with energies of 80 kV and 140 kV, which results in characteristic differences in CT numbers in urate and calcium compounds. The characterization of mineral deposition without joint aspiration for crystal analysis with polarized light microscopy allows for rapid, noninvasive diagnosis or exclusion of crystalline arthropathy. DECT may also be used to monitor response to medical therapy. The basic physics of DECT, common associated artifacts, and potential pitfalls will be presented by clinical case examples.

TABLE OF CONTENTS/OUTLINE
Review fundamentals of DECT Interpretation of DECT: conventional, 3D reconstructed, and fused color images DECT artifacts: nail or nail bed, skin, coloring of single pixels or areas less than 1 mm, beam hardening, calcified vessels, motion, thin bone, and clothing Potential pitfalls: calcified intraarticular bodies, acroosteolysis, fracture callus Clinical case examples of crystalline arthropathy characterized by DECT in the different joints of the extremities and spine
Are You Ready to Muscle Up? The Imaging of CrossFit Injuries

All Day Location: MK Community, Learning Center

TEACHING POINTS

The activity of CrossFit continues to gain popularity as an exercise program. Specific unique exercises in a CrossFit workout can put athletes at risk for common and uncommon injuries. Familiarity with unique exercises in a CrossFit workout is beneficial to the radiologist who is asked to image an athlete injured during a CrossFit workout by better understanding the mechanism of injury and possible pathologies.

TABLE OF CONTENTS/OUTLINE

Purpose/Aim: The purpose of this exhibit is to spotlight several exercises unique to CrossFit and explore cases of injuries which occurred with each exercise. Content Organization: • Review the basic principles and components of a CrossFit exercise program. • Highlight several exercises unique to CrossFit using diagrams and videos. • For each spotlighted CrossFit exercise, we will provide examples of injuries which resulted from the exercise with a focus on the injury mechanism. • In addition, for each injury we will review the relevant anatomy, clinical presentation, imaging appearance and treatment options. Summary: CrossFit is an exercise program which continues to gain popularity. Familiarity with a variety of different CrossFit exercises allows the radiologist to better understand potential injuries that these athletes may encounter.

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Daniel E. Wessell, MD, PhD - 2013 Honored Educator
How New MRI Measures of Pelvic Morphology Can Help Us Identify Patients Predisposed to Ischiofemoral Impingement (IFI)

All Day Location: MK Community, Learning Center

Participants
Imran Hafeez, Brooklyn, NY (Presenter) Nothing to Disclose
Giuseppe Cruciata, MD, Brooklyn, NY (Abstract Co-Author) Nothing to Disclose
Eric J. Ledermann, DO, MBA, Brooklyn, NY (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
1.) To understand the clinical significance, presentation and evolution of ischiofemoral impingement, and how it is to be diagnosed with MR imaging of the hip and/or pelvis.
2.) To understand how new MRI measures, namely an increased ischial angle and increased femoral neck angle, are correlated with and may predispose towards ischiofemoral impingement.

TABLE OF CONTENTS/OUTLINE
Clinical Presentation and pathophysiology of ischiofemoral impingement (IFI) Comparison with femoral acetabular impingement (FAI) Review of recently proposed MRI measures - Ischial angle - Femoral neck angle Sample cases Future directions and summary
Posterolateral Corner: How to Make it Easy. Multimodality Imaging with Illustrative Review of Anatomy and Component Injuries

All Day Location: MK Community, Learning Center

Participants
Pablo Schwartzman, Buenos Aires, Argentina (Presenter) Nothing to Disclose
Jose Buteler, PhD, Tucuman, Argentina (Abstract Co-Author) Nothing to Disclose
Diego Salgado, MD, Ciudad Autonoma de Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Veronica Alarcon, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Agustin Fernandez Vina, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
Gonzalo Galparsoro, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The posterolateral corner is an uncommon site of lesions, which are usually found in the spectrum of ACL or PCL tears. It has several tendinous and ligamentous structures, which makes it particularly difficult to evaluate in a conventional MRI. His knowledge is of fundamental importance as it can modify the surgical treatment. The goal of this exhibit is to present in detail the complex anatomy and imaging findings of posterolateral corner anatomy and associated pathology.

TABLE OF CONTENTS/OUTLINE
Musculoskeletal Correlates of Intra-abdominal Disease: What to Look For

All Day Location: MK Community, Learning Center

Participants
Cynthia A. Britton, MD, Pittsburgh, PA (Presenter) Nothing to Disclose

TEACHING POINTS

After review of known musculoskeletal manifestations associated with intraabdominal disease in this exhibit, the reader should be capable of: 1. Detection of pertinent accompanying skeletal findings in the company of known intraabdominal disease and guide further clinical or radiologic work-up if appropriate. 2. Suggest further investigation of a previously unsuspected intraabdominal pathology upon discovery of skeletal abnormalities which may be associated with intraabdominal disease.

TABLE OF CONTENTS/OUTLINE

Intraabdominal diseases which have musculoskeletal correlates include the following categories which will be illustrated:
1. Syndromes: Gardner's syndrome, nail-patella syndrome, Erdheim-Chester disease
2. Metabolic diseases: oxalosis, hemosiderosis, amyloidosis, Gaucher's disease, sickle-cell disease
3. Auto-immune disorders: scleroderma, HLA B27 associated inflammatory bowel disease
4. Organ failure related to bone metabolism: CRF/secondary hyperparathyroidism, pancreatitis and cirrhosis
**Myxoinflammatory Fibroblastic Sarcoma: A Review of Cases at a Large Academic Institution**

**All Day Location:** MK Community, Learning Center

**Participants**
Kara D. Gaetke-Udager, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose  
Corrie M. Yablon, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose  
David R. Lucas, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose  
Yoav Morag, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**
After review of this exhibit, the learner will be able to: Discuss the tumor's demographic and pathologic characteristics Describe its range of imaging findings on radiographs and MR Understand clinical and surgical considerations

**TABLE OF CONTENTS/OUTLINE**
**Introduction**
Low-grade soft tissue neoplasm Most common in distal extremities Pathologic characteristics Complex mixture of ganglion-like cells on inflamed myxoid and fibrosclerotic background Rarely cause osseous destruction Rarely metastasize Clinical considerations Frequently recur Complete surgical resection is crucial Use of adjuvant therapy uncommon Imaging findings in our case series Radiographs Soft tissue mass sometimes seen Osseous destruction is rare MRI T1-weighted images Usually high signal Some lesions have fat signal T2-weighted images Usually high signal Can be heterogeneous Post-contrast images: variable Diffuse homogeneous enhancement Thin peripheral enhancement Conclusions Rare tumor, usually of distal extremities Varied clinical and radiologic presentation Should be considered in the differential diagnosis of soft tissue masses in hands and feet Local recurrence is frequent and complete resection is needed
MK142-ED-X

Bone Metastases from Head and Neck Cancer: Retrospective Analysis of Whole Body MRI (WB-MRI), FDG-PET and CT

All Day Location: MK Community, Learning Center

Participants
Katsuyuki Nakanishi, MD, PhD, Osaka, Japan (Presenter) Nothing to Disclose
Naoyuki Kanayama, Osaka, Japan (Abstract Co-Author) Nothing to Disclose
Takashi Fujii, Osaka, Japan (Abstract Co-Author) Nothing to Disclose
Toshinari Yagi, Osaka, Japan (Abstract Co-Author) Nothing to Disclose
Nobuhiro Araki, Osaka, Japan (Abstract Co-Author) Nothing to Disclose
Noriyuki Tomiyama, MD, PhD, Suita, Japan (Abstract Co-Author) Nothing to Disclose

TABLE OF CONTENTS/OUTLINE

Educational Abstract Review on a New Procedure. WB-MRI as a new method for bone metastases from HNC which are rare.
TEACHING POINTS

1. Review physical principles and techniques of PET-MRI (positron emission tomography-magnetic resonance imaging). 2. Discuss clinical utility of using functional information obtained from a PET scan and structural information obtained from MR imaging in evaluating musculoskeletal neoplasms.

TABLE OF CONTENTS/OUTLINE

**Musculoskeletal Sunday Poster Discussions**

**Sunday, Nov. 29 12:30PM - 1:00PM Location: MK Community, Learning Center**

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**Participants**
Michael G. Fox, MD, Charlottesville, VA (Moderator) Stockholder, Pfizer Inc;

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**Sub-Events**

**MK318-SD-SUA1**
**T2* Mapping of the Subchondral Tissue using Ultra Short TE MRI: Comparison to the International Cartilage Repair Society (ICRS) Grade by Arthroscopy in Sports Trauma Patients**

**Station #1**

**Participants**
Takako Aoki, PhD, Iruma-Gun, Japan (Presenter) Nothing to Disclose
Mamoru Niitsu, MD, Saitama, Japan (Abstract Co-Author) Nothing to Disclose
Yomei Tachibana, MD, PhD, Kawagoe, Japan (Abstract Co-Author) Nothing to Disclose
Naoki Sugita, MD, Iruma-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Tsuyoshi Sasaki, RT, Moroya, Japan (Abstract Co-Author) Nothing to Disclose
Ichiro Oosawa, Iruma-Gun, Japan (Abstract Co-Author) Nothing to Disclose
Takashi Ushimi, MD, PhD, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose
Hiroshi Imai, MS, RT, Tokyo, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To investigate the microenvironment change of subchondral tissue using ultra short TE-T2* (UTE-T2*) mapping. Microenvironment changes of extracellular matrix (ECM) by traumatic injury can lead to abrupt alteration in physical tissue properties and may increase the future risk of osteoarthritis (OA).

**METHOD AND MATERIALS**
This study was performed under an IRB approved protocol. T2* value of the subchondral tissue in fifteen patients (age range 20-47 years), scheduled for arthroscopic reconstruction surgery of the anterior cruciate ligament (ACL) and/or meniscal repair was measured preoperatively, and they were classified according to the International Cartilage Repair Society (ICRS) grade (0-4) postoperatively. MRI was performed using prototype UTE sequence on a 3T clinical scanner (Siemens MAGNETOM Skyra). Each images (TE: 0.4, 0.6, 0.8, 1.0 ms) of four echo time were collected with section thickness of 0.78 mm isotropic voxel. Region of interests (ROI) were set on the subchondral regions of medial and lateral center of femoral condyle (cMF, cLF), medial and lateral center of tibia (MT, LT), patella and trochlea (excluded any injury area) for T2* measurement.

**RESULTS**
Mean T2* of cMF with ICRS grade 0 (n=6), grade 1(n=4), grade 2 (n=3) and grade 3 (n=2) were 0.86±0.46 ms, 1.16±0.68 ms, 1.29±1.10 ms and 1.70±0.17 ms, respectively. Similarly, mean T2* of cLF with ICRS grade 0, 1, 2 and 3 were 0.71±0.17, 0.81±0.4, 0.96±0.33 and 1.17±0.49. T2* value was increased following the ICRS grading, and damaged region indicated the highest T2* value. However, especially at cMF and patella, higher T2* values were confirmed in regardless of the grade.

**CONCLUSION**
In general, ICRS grade and T2* value indicated parallel increase, however, did not necessarily correlate for all of the ROIs. Instead of the arthroscopy, evaluating the surface of the cartilage, T2 *mapping of the subchondral tissue can predict the potential internal change toward the OA.

**CLINICAL RELEVANCE/APPLICATION**
Quantitative assessment of subchondral tissue by UTE-T2 * will be helpful for risk of OA in future.

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**MK319-SD-SUA2**
**Hypodermal Adipose Tissue Sonoelastography for Monitoring Treatment Response in Patients with Plaque Psoriasis**

**Station #2**

**Participants**
Manlio Gazzaroni, Roma, Italy (Abstract Co-Author) Nothing to Disclose
Simone Altabelli, Rome, Italy (Presenter) Nothing to Disclose
Salvatore Marsico, Naples, Italy (Abstract Co-Author) Nothing to Disclose
Silvia D’Onofrio, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Daniela Tosti, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Annunziata Dattola, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Sergio Chimenti, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Giovanni Simonetti, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Improving ultrasonographic assessment with Sonoelastography was successful in evaluating chronic inflammation in different organs. The purpose of our study is to evaluate hypodermal adipose tissue inflammation underneath psoriasis plaques quantifying tissue elasticity with sonoelastography before and after treatment with topic therapy, sistemic therapy with DMARDS or biologic drugs.
METHOD AND MATERIALS
From September 2014 to March 2015, we enrolled 60 patients with plaque psoriasis with a PASI (5-10). On the basis of clinical examination they were divided in 3 groups of treatment depending on the prescribed drug: topic therapy (Group A), sistemic therapy with DMARDs (Group B) and biologic drugs therapy (Group C). A baseline (T0) ultrasound examination with sonoelastography was performed before the beginning of drugs assumption. At this time the mean strain ratio (muscle to hypodermal adipose tissue), resulting from the averaging of three measurement, underneath the chosen psoriasis plaque was recorded and compared with the one obtained by analysing the same tissues underneath normal surrounding skin. A follow up clinical and ultrasonographic examination (T1) was performed after one month of treatment to evaluate therapy response. At this time a comparison was made between T0 and T1 obtained mean strain parameters and overall clinical response.

RESULTS
At T0 lesional mean strain ratio (muscle to hypodermal adipose tissue) was significantly higher than non-lesional one; thus documenting an high grade of stiffness of the hypodermal fat underneath psoriasis evaluated plaques. The strain ratio showed no statistically significant difference according to gender (p=0.59). T1 examination data obtained from the 3 selected groups of patients documented a significant decrease in stiffness when comparing group B and C together with group A and group C with both group A and B. Mean strain ratio decrease correlated with clinical PASI improvement in all the responder patients in the considered groups. Non-responders demonstrated a persistent high tissutal stiffness.

CONCLUSION
Sonoelastography is able to identify hypodermal adipose tissue involvement in plaque psoriasis and it represents a valid method to assess early therapy response in patient with plaque psoriasis

CLINICAL RELEVANCE/APPLICATION
Hypodermal adipose tissue involvement in plaque psoriasis can be quantified with sonoelastography and could be used as marker of treatment response

Mk320-SD- SUA3 Sonographic Evaluation of Morton's Neuroma Prior to and Following Laser Therapy

Participants
David Melville, MD, Tucson, AZ (Presenter) Nothing to Disclose
Matthew P. Del Giudice, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Darin A. Bocian, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Lana H. Gimber, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose
Elizabeth A. Krupinski, PhD, Atlanta, GA (Abstract Co-Author) Institutional research contract, EIZO Corporation
Miha S. Taljanovic, MD, Tucson, AZ (Abstract Co-Author) Nothing to Disclose

PURPOSE
To retrospectively assess for differences in imaging appearances of Morton's neuromas prior to and following laser therapy using ultrasound (US).
Eugenio Rimondi, MD, Bologna, Italy (Abstract Co-Author) Nothing to Disclose
Alberto Bazzocchi, MD, Bologna, Italy (Abstract Co-Author) Nothing to Disclose
Alessandro Gasbarrini, Bologna, Italy (Abstract Co-Author) Nothing to Disclose
Ugo Albisinni, MD, Bologna, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
The aim of this study was to evaluate efficacy and complications of CT-guided radiofrequency ablation (RFA) of spinal osteoid osteoma (OO).

METHOD AND MATERIALS
Between 2002 and 2012, 61 patients (46 males and 15 females - mean age 26.4±12.7 yo) were submitted to RFA for spinal OO. The diagnosis of OO was made after a period of pain and symptoms of 20.6±14.4 months. RFA was performed under conscious sedation and local analgesia. Clinical symptoms were evaluated at 3-6-12 months, and at the end of the time of the present investigation. Mean follow-up was 41.5±7.1 months.

RESULTS
The primary efficacy of RFA, complete regression of symptoms was obtained in 57/61 (93.4%) patients. Four of 61 (6.5%) patients showed a relapse of OO (after 3 months); 2/4 were submitted to a second RFA, the others were submitted to surgery.

Complications accounted for a disc herniation and lower limb formication for 30 days after the ablation.

CONCLUSION
CT-guided RFA is an excellent treatment for spinal OO. Our data suggest that this procedure should be considered for the first step therapy of this disease.

CLINICAL RELEVANCE/APPLICATION
The safety and effectiveness of CT-guided RFA in the treatment of spinal OO suggest that this minimally invasive procedure can replace spine surgery.

MK322-SD-SUA5
Whole-Body MRI: Value in Chronic Recurrent Multifocal Osteomyelitis (CRMO) and Synovitis, Acne, Pustulosis, Hyperostosis, and Osteitis (SAPHO)

Station #5

Participants
Roxanne Giggens, MBBS, Oxford, United Kingdom (Presenter) Nothing to Disclose
Karen J. Partington, MBChB, MRCS, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE
CRMO and SAPHO are characterised by multifocal non-infective osteomyelitis. Lesions are often asymptomatic and therefore, if suspected, whole-body screening is useful to determine multifocality. We aim to evaluate the role of whole-body MRI in the diagnosis, exclusion, and follow-up of CRMO and SAPHO.

METHOD AND MATERIALS
We retrospectively reviewed 22 whole-body MRI examinations performed in 19 patients (12 females, 7 males; age range 10-54 years) for suspected, or known CRMO or SAPHO between May 2012 and February 2015. The protocol consisted of coronal T1-weighted and STIR sequences. The number and location of osseous lesions were evaluated and compared with previous radiological examinations.

RESULTS
14 scans were performed for suspected diagnosis of CRMO or SAPHO; 5/14 (36%) showed a single site of disease and 9/14 (64%) showed multifocal disease. In the multifoc group, 19 previously undetected lesions were visualised in 6/9 (67%) patients. MR findings were used to guide biopsy location in 5 patients. 8 scans were performed to assess disease severity in patients with known multi-focal CRMO or SAPHO; 6/8 (75%) showed a change in disease burden compared to previous imaging, with 4 new or worsening lesions, and 12 lesions showing improvement or resolution.

CONCLUSION
Whole-body MRI can demonstrate multifocal disease, including asymptomatic lesions, in CRMO and SAPHO without exposure to ionising radiation. In our series we have shown that whole-body MRI is useful for establishing a diagnosis, visualising occult lesions, providing a baseline of disease distribution, guiding treatment and allowing follow-up to evaluate progression and resolution.

CLINICAL RELEVANCE/APPLICATION
In patients with suspected or confirmed CRMO or SAPHO, whole-body MRI is an ideal initial, and follow-up, diagnostic tool that does not involve ionising radiation.

MK105-ED-SUA6
Sonographic and MR Evaluation of Pectoralis Major Injury

Station #6

Participants
Yauk Lee, MD, San Jose, CA (Presenter) Nothing to Disclose
Eric A. White, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose
Anderanik Tomasion, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Diane Phan, Richmond, VA (Abstract Co-Author) Nothing to Disclose
Dakshesh B. Patel, MD, Porter Ranch, CA (Abstract Co-Author) Nothing to Disclose
George R. Matcuk JR, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Aaron Schein, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
TEACHING POINTS

This exhibit will provide an instructive guide to the sonographic and MR evaluation of pectoralis major injuries with an emphasis on imaging protocol, findings, and classification.

TABLE OF CONTENTS/OUTLINE

1. Pathophysiology of osteoarthritis and disease burden in national and global population. 2. Different types of knee prosthesis and their design. 3. Radiographic preoperative assessment of knee a) Severity of OA: Kellgren-Lawrence grading system b) Measurement of knee angle, mechanical axis, tibial translation, tibial slope and joint line asymmetry c) Status of mineralization d) Periarticular soft tissue including muscle bulk e) Templating to choose appropriate prosthesis. 4. Postoperative radiographic assessment a) Immediate post operative radiographs b) baseline followup to assess alignment c) Short term complications with radiographic features d) Long term complications with radiographic features

MK149-ED-SUA7

Reimbursement for Musculoskeletal Imaging and Procedures: Understanding the Critical Role of the Relative Value Unit

Station #7

Participants
Yuri E. Peterkin, MD, Mineola, NY (Presenter) Nothing to Disclose
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Joseph P. Mazzie, DO, Mineola, NY (Abstract Co-Author) Nothing to Disclose
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Michael K. Brooks, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. An understanding of the Relative Value Unit (RVU) is essential to the musculoskeletal radiologist, as this is what determines reimbursement. 2. The total payment for a musculoskeletal procedure or imaging study is calculated by multiplying the total RVU by a conversion factor. This conversion factor is updated annually. 3. Musculoskeletal radiologists must be aware of current issues regarding reimbursement and potential future payment models.

TABLE OF CONTENTS/OUTLINE

Review the history of medical reimbursement in the United StatesDetail the development of the currently used RVU system, focusing on musculoskeletal imaging and procedures-The Omnibus Budget Reconciliation Act-Explanation of the RVU components and their calculation-Define the role of the RUC (Relative Value Scale Update Committee)Provide examples of RVU calculations for MSK studies and procedures, including (but not limited to):-x-ray-CT-MRI-Ultrasound-Ultrasound and fluoro guided joint aspiration-CT guided bone biopsy-MR arthrogram-Percutaneous bone tumor ablationHighlight the payment differences between facility and non-facility locations, and discuss the reasons for such differencesReview current literature on this topic, providing musculoskeletal radiologists with an improved understanding of how changes in healthcare may alter reimbursement

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Douglas S. Katz, MD - 2013 Honored Educator
Douglas S. Katz, MD - 2015 Honored Educator

MK194-ED-SUA8

Total Knee Replacement: What an Orthopedics Surgeon Wants to Know from Radiologist?

Station #8

Participants
Dane G. Mackey, MD, New Orleans, LA (Abstract Co-Author) Nothing to Disclose
Vinod Dasa, New Orleans, LA (Abstract Co-Author) Consultant, myoscience, Inc; Consultant, Ferring Group; Consultant, Bioventus LLC; Research support, Cropper Medical Inc; Consultant, Sanwa Kagaku Kenkyusho Co, Ltd
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Michael L. Manistany, MD, New Orleans, LA (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

The purpose of the exhibit is to a) Review preoperative radiographic assessment prior to knee replacement. b) Become familiar with common types of knee prosthesis and their radiographic appearances. c) Recognize post-operative complications and their radiographic appearances.

TABLE OF CONTENTS/OUTLINE

1. Pathophysiology of osteoarthritis and disease burden in national and global population. 2. Different types of knee prosthesis and their design. 3. Radiographic preoperative assessment of knee a) Severity of OA: Kellgren-Lawrence grading system b) Measurement of knee angle, mechanical axis, tibial translation, tibial slope and joint line asymmetry c) Status of mineralization d) Periarticular soft tissue including muscle bulk e) Templating to choose appropriate prosthesis. 4. Postoperative radiographic assessment a) Immediate post operative radiographs b) baseline followup to assess alignment c) Short term complications with radiographic features d) Long term complications with radiographic features
TEACHING POINTS

To demonstrate the spectrum of MRI findings in diabetic pedal osteomyelitis To compare MRI features of pedal osteomyelitis with other conditions which both mimic and may coexist with osteomyelitis To demonstrate MRI features of soft tissue findings in pedal osteomyelitis

TABLE OF CONTENTS/OUTLINE

Clinical relevance: Patients with advanced complications of diabetes are overrepresented in indigent and underserved communities. At our institution approximately 300 cases of pedal osteomyelitis are reported on MRI annually. MRI evaluation: Demonstrate MRI features of osteomyelitis from early to advanced bony involvement. Contrast MRI findings of pedal osteomyelitis with MR features of neuroarthopathy, a common mimicker. Distinguish reactive marrow edema from osteomyelitis, with a focus on STIR and T1 weighted imaging features. Discuss specific features of septic arthritis with osteomyelitis. Review MRI criteria for diagnosing intra-osseous abscess. Demonstrate MRI appearance of sinus tracts on T1, T2 and post-contrast images. Focus on utility of T2, post-contrast, and DWI imaging in diagnosing soft tissues abscesses. Provide examples of pedal osteomyelitis with fracture versus fracture alone. Demonstrate MRI appearance of pedal osteomyelitis with adjacent tendon rupture.
### Muscle Cross-Sectional Area and Strength of Knee Extensors and Flexors Impact Compartment-Specific Cartilage Health- A Longitudinal 3T MRI Study from the Osteoarthritis Initiative

**PURPOSE**

To determine in a 48-month longitudinal study the effect of thigh muscle cross-sectional area (CSA) and strength, and specifically the ratio of extensor to flexor CSA (E/F ratio) on the progression of compositional and morphologic knee cartilage degeneration using 3T magnetic resonance imaging (MRI).

**METHOD AND MATERIALS**

Seventy subjects were selected from the Osteoarthritis Initiative (OAI). Subjects were only included if they were age 50-60, had no radiographic osteoarthritis (OA) and had constant muscle strength over 48 months as measured by isometric knee extension testing. For each patient, baseline CSA of the right thigh muscles was assessed on axial 3T MRI T1 weighted images and adjusted for intramuscular fat by a Goutallier-derived correction factor. E/F ratio was calculated as the ratio of extensor to flexor CSA. Extent of knee damage at baseline and 48-months was graded on right knee 3T MRI images using a modified whole organ MRI score (WORMS). Knee cartilage was segmented in 5 compartments (excluding the trochlea) at baseline and 48-months, and MRI T2 relaxation times were computed. Statistical analysis employed student's t-test, multiple regression models and one-way analysis of variance.

**RESULTS**

We found that isometric chair-based knee extension strength was significantly positively correlated with mean thigh CSA at baseline (r=0.655, p<0.001). The E/F ratio had a significant direct association with progressive longitudinal deterioration of patellar cartilage (p=0.001). Interestingly, however, E/F ratio had a significant inverse association with longitudinal change in T2 values of the lateral femoral compartment (p=0.011), with a similar statistical trend in the medial femoral compartment (p=0.075), consistent with decreased compositional tibio-femoral joint cartilage degeneration.

**CONCLUSION**

Our results suggest that while high E/F CSA ratios of thigh muscle are associated with greater morphological degeneration at the patellofemoral joint, they simultaneously provide a protective effect for the tibio-femoral joint cartilage.

**CLINICAL RELEVANCE/APPLICATION**

Based on the results of this study, physiotherapeutic management of patients with mostly patellofemoral or tibio-femoral OA may differ with targeted strengthening of different muscle compartments.

### Osteoarthritis (OA) of the Knee: Platelet Rich Plasma (PRP) Intrarticular Injection versus Hyaluronic Acid (HA) Viscosupplementation

**PURPOSE**

To evaluate the results after HA and PRP intra-articular therapy in OA of the knee.

**METHOD AND MATERIALS**

On the basis of clinical and radiological diagnosis of OA of the knee (patient with grade 1, 2 or 3 osteoarthritis according to the Kallgren and Lawerence scale), we treated 270 patients with HA (140 pts, Group A) and PRP (130 pts, Group B). Exclusion criteria
were rheumatic and hematolgy diseases. We performed MRI, clinical (VAS) and functional evaluation (WOMAC) before and 1 year after treatment. Group A included patients treated with HA and Group B those treated with PRP. We subsequently divided these groups into two subgroups to homogenize the results on the basis of age: Group Aa (95 pts aged 62-81) and Group Ab (45 pts aged 36-61); Group Ba (82 pts aged 62-81) and Group Bb (48 pts aged 36-61). We used an imaging scale ranging from 0 to 11, on the basis of distribution of joint effusion (subquadriceps bursa, anterior/posterior recess, gastrocnemius-semimembranosus and popliteal bursa), chondral damage side (medial tibio-femoral, lateral, patello-femoral), and presence or not of subchondral edema.

RESULTS

Group Aa: MRI showed improvement of 66% (10 pre-treatment and 5 after), VAS improvement of 43% and Womac of 67%; Group Ab: MRI showed improvement of 28% (7 pre-treatment and 5 after) VAS improvement of 48 % and Womac of 40 %. Group Ba: MRI showed improvement of 31% (10 pre-treatment and 7 after), VAS improvement 33% and Womac 36%; Group Bb: MRI showed improvement of 84% (7 pre-treatment and 2 after); VAS improvement of 85% and Womac.

CONCLUSION

Our experience proves that the US-guided intra-articular injection of PRP is a good solution for primary OA of the knee, especially for young patients; conversely, for older patients, treatment with HA seems to be more effective.

CLINICAL RELEVANCE/APPLICATION

The treatments with PRP and HA are a valid alternative to physical, medical and surgical therapy for the patients with OA of the knee, especially for the efficacy in terms of reduction of symptoms.

MK325-SD-SUB3

CT Guided Minimally Invasive Percutaneous Treatment for Lumbar Disk Pathology: The Ozone Nucleolysis

Participants

Federico D'Orazio, Laquila, Italy (Presenter) Nothing to Disclose
Lorenzo Maria Gregori, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
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Massimo Gallucci, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the clinical effectiveness and morphologic changes in disk herniation after intradiscal, periganglionic and periradicular oxygenozone (O2O3) injection.

METHOD AND MATERIALS

From July 2010 to April 2014, we performed O2O3 chemonucleolysis in 1432 patients with low back pain and radicular pain secondary resistant to conservative therapy. Under CT guidance, intradiscal and periganglionic injection was administered with a paravertebral approach in 952 patients and an interlaminar approach in 540 patients by using 9 mg spinal needle. An Oswestry Low Back Pain Disability Questionnaire was administered before treatment and at intervals, the last at 6 month followup. The discs diseases treated were classified according to the nomenclature of the ASNR (bulging, protrusion, extrusion, free fragment).

RESULTS

After 6 months, treatment was successful in 1072 (74.9%) patients. In the remaining 360 (25.1%) patients treatment was considered to have failed. The treatment was clinically successful in 88% of the extrusion, 79% of protrusions, in 61% of bulging and 51% of patients with concomitant degenerative phenomena.

CONCLUSION

Our study shows that the intradiscal oxygen injection is effective in the treatment of intervertebral disk pathology. For this reason, oxygen-ozone injection is an option to treat lumbar disk herniation that has failed to respond to conservative therapy.

CLINICAL RELEVANCE/APPLICATION

In patients not responding to conservative therapy and refusing surgery, ozone injection can be safely administered to get relief from symptoms.

MK326-SD-SUB4

Can Combined Treatments be more Effective than RT Only for Painful Bone Metastasis? Our Experience with CT-guided Ablation with Radio-frequency and RT (RFA-RT); Microwave and RT (MW-RT); Cryotherapy and RT (CRYO-RT)

Participants

Andrea Mancini, MD, Laquila, Italy (Presenter) Nothing to Disclose
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Alice La Marra, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Mariani, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the effectiveness of percutaneous CT-guided ablation with RF or MW or CRYO added to RT versus RT only in the relief
of bone metastasis pain.

**METHOD AND MATERIALS**

From May 2007 to today, 54 oncologic patients were evaluated for a single painful bone metastasis. All lesions were larger than 3 cm with a central poorly oxygenated and necrotic area. Before ablation treatment for each patient we realized a validated visual analogic scale (VAS) for pain assessment. Inclusion criteria was VAS from 4 to 10. Exclusion criteria was the presence of other metastasis. Ablation had the role to destroy the necrotic center, which is unlikely to be treated by RT. By CT-guiding the ablation was done in 26 patients with radio-frequency (LeVeen needle electrode Boston Scientific Corporation), 8 patients with microwave (Single Evident Antenna, Covidien) and 20 patients with cryosystem (IceSeed, Galil Medical). All ablations were followed after 6 days by single fraction RT at 800 cGy.

**RESULTS**

Patients had pain relief for a period from 3 to 15 months (mean 8.1 months for CRYO, 7.4 for RF and 7.0 for MW) versus 3 to 15 months (mean 2.4-3 months) of RT (datas from literature). Technical success was 100%. No major complications occurred. The mean VAS after all ablations improved overall by 85% from 9.1 to 1.1 (mean 1.7).

**CONCLUSION**

These datas suggest that, in comparison with RT only, the adding of RF or MW or CRYO ablation can lead to a significant improvement in terms of pain relief in patients with painful bone metastasis.

**CLINICAL RELEVANCE/APPLICATION**

The CT-ablations improve the effectiveness of the treatment of the RT only because they act on the necrotic areas and can reduce the pain in the short term.

**PURPOSE**

To compare apparent diffusion coefficient (ADC) of fluid attenuated inversion recovery diffusion weighted imaging (FLAIR-DWI) to the ADC obtained with conventional DWI in lumbar bone marrow of patients with acute leukemia (AL), and to analyze the accuracy of ADC values of FLAIR-DWI in evaluating treatment response.

**METHOD AND MATERIALS**

Fifty-three patients with AL underwent MRI on GE Signa Excite 1.5T. Sagittal lumbar bone marrow was performed in conventional DWI sequence (b value=0,500s/mm²) and FLAIR-DWI (b value=0,500s/mm²,TI=2500ms). The ADC values derived from different DWI sequences were measured on ADC map respectively. 53 cases were divided into 28 untreated patients (including 114 vertebrae) and 25 treated patients (including 115 vertebrae). On base of treatment response, 25 treated patients were composed of 18 cases with complete remission (including 82 vertebrae) and 7 cases with non remission (including 33 vertebrae). The percentage of primitive leukemia cell in bone marrow were recorded.

**RESULTS**

In untreated patients, the ADC values of conventional DWI and FLAIR-DWI were (0.479±0.104),(0.445±0.115)×10⁻³mm²/s respectively, there was statistically significant difference between different ADC values (t=3.805, p<0.05). There was similar results (t=10.078, p<0.05) in treated patients, the ADC values of conventional DWI and FLAIR-DWI were (0.718±0.261) and (0.568±0.248)×10⁻³mm²/s respectively. The rate(20.89%) of decline from ADC values of conventional DWI to FLAIR-DWI was higher in treated group than that(7.10%) in untreated. The ADC values of FLAIR-DWI demonstrated good correlations with percentage of primitive leukemia cell of bone marrow in untreated patients (r=0.384, p=0.0043), but not in treated patients (r=-0.086, p=0.726). The ADC values of FLAIR-DWI were higher sensitivity and specificity in evaluating treatment response with area under the curve (AUC) of 0.794 than ADC values of conventional DWI with AUC of 0.695.

**CONCLUSION**

FLAIR-DWI can reduce ADC value of bone marrow in AL by suppressing the signal of free water. It may improve the accuracy of evaluating treatment response in patients with AL.

**CLINICAL RELEVANCE/APPLICATION**

On contrast to bone marrow biopsy, the results of this subject will provide a noninvasive method for evaluating treatment response in patients with AL.

**MK327-SD-SUB5**

**Fluid Attenuated Inversion Recovery DWI in Evaluation of Treatment Response in Acute Leukemia: Comparison with Conventional DWI**

**Participants**

Jinliang Niu, MD, PhD, Shanxi, China (Presenter) Nothing to Disclose
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Xue Tian, Taiyuan, China (Abstract Co-Author) Nothing to Disclose
Dandan Zheng, Urumchi, China (Abstract Co-Author) Nothing to Disclose
Xiaohong J. Zhou, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare apparent diffusion coefficient (ADC) of fluid attenuated inversion recovery diffusion weighted imaging (FLAIR-DWI) to the ADC obtained with conventional DWI in lumbar bone marrow of patients with acute leukemia (AL), and to analyze the accuracy of ADC values of FLAIR-DWI in evaluating treatment response.

**METHOD AND MATERIALS**

Fifty-three patients with AL underwent MRI on GE Signa Excite 1.5T. Sagittal lumbar bone marrow was performed in conventional DWI sequence (b value=0,500s/mm²) and FLAIR-DWI (b value=0,500s/mm²,TI=2500ms). The ADC values derived from different DWI sequences were measured on ADC map respectively. 53 cases were divided into 28 untreated patients (including 114 vertebrae) and 25 treated patients (including 115 vertebrae). On base of treatment response, 25 treated patients were composed of 18 cases with complete remission (including 82 vertebrae) and 7 cases with non remission (including 33 vertebrae). The percentage of primitive leukemia cell in bone marrow were recorded.

**RESULTS**

In untreated patients, the ADC values of conventional DWI and FLAIR-DWI were (0.479±0.104),(0.445±0.115)×10⁻³mm²/s respectively, there was statistically significant difference between different ADC values (t=3.805, p<0.05). There was similar results (t=10.078, p<0.05) in treated patients, the ADC values of conventional DWI and FLAIR-DWI were (0.718±0.261) and (0.568±0.248)×10⁻³mm²/s respectively. The rate(20.89%) of decline from ADC values of conventional DWI to FLAIR-DWI was higher in treated group than that(7.10%) in untreated. The ADC values of FLAIR-DWI demonstrated good correlations with percentage of primitive leukemia cell of bone marrow in untreated patients (r=0.384, p=0.0043), but not in treated patients (r=-0.086, p=0.726). The ADC values of FLAIR-DWI were higher sensitivity and specificity in evaluating treatment response with area under the curve (AUC) of 0.794 than ADC values of conventional DWI with AUC of 0.695.

**CONCLUSION**

FLAIR-DWI can reduce ADC value of bone marrow in AL by suppressing the signal of free water. It may improve the accuracy of evaluating treatment response in patients with AL.

**CLINICAL RELEVANCE/APPLICATION**

On contrast to bone marrow biopsy, the results of this subject will provide a noninvasive method for evaluating treatment response in patients with AL.
DETECTION OF TEARS OF THE PLANTAR PLATE
MRI WITH INTRAVENOUS CONTRAST MEDIA FOR EVALUATION OF THE PLANTAR PLATE AND ADJACENT ANATOMY OF THE METATARSOPHALANGEAL JOINTS

TABLE OF CONTENTS/OUTLINE

1. The "unhappy tilt" sign of the flexor tendon on MRI helps detect injuries of the plantar plate and adjacent capsule. 2. Disruption of the "Fu Manchu mustache" appearance of the interosseous tendons helps detect tendinosis and tear. 3. These signs can be detected even on non-contrast MRI but are more conspicuous with contrast media. 4. MR arthrography with intra-articular injection of dilute gadolinium contrast media into the metatarsophalangeal joint provides excellent delineation of tears of the plantar plate detected even on non-contrast MRI but are more conspicuous with contrast media. 5. MRI with intravenous contrast media is a less invasive alternative to MR arthrography, and provides better assessment of other potential sources of pain in the forefoot and joint capsule that helps with surgical planning.

TEACHING POINTS

MRI for Injuries of the Plantar Plate, Adjacent Joint Capsule, and Interosseous Tendons: Ten-year Experience and New Imaging Signs

TABLE OF CONTENTS/OUTLINE

Anatomy of the Metatarsophalangeal Joints
Noncontrast MRI for Evaluation of the Metatarsophalangeal Joints
MR Arthrography for Detection of Tears of the Plantar Plate
MRI with Intravenous Contrast Media for Evaluation of the Plantar Plate and Adjacent Capsule
MRI for Detection of Injuries of the Interosseous Tendons
MR Imaging of Dislocation of the Metatarsophalangeal Joint
Technical Optimization of MRI for the Metatarsophalangeal Joints

Coracoid: The Lighthouse of the Shoulder

TABLE OF CONTENTS/OUTLINE

Illustrations of normal coracoid anatomy including muscle (pectoralis minor, short head of the biceps brachii, and coracobrachialis) and ligament attachments (coracoclavicular, coracohumeral, coracoacromial, and suprascapular) Variant anatomy Coracoid fractures: mechanisms, imaging, classification, associated injuries, and management Subcoracoid impingement: presentation, imaging, and treatment Coracoacromial arch, impingement, and rotator cuff pathology Coracohumeral ligament and the biceps pulley Coracoclavicular ligament injury and reconstruction Subcoracoid triangle sign in adhesive capsulitis Subcoracoid bursitis: causes and differentiation from subscapularis recess Coracoid transfer for anterior shoulder instability Tumors

Coracoid: The Lighthouse of the Shoulder

TEACHING POINTS

Coracoid: The Lighthouse of the Shoulder

An Osseous Odyssey: A Woman's Life as Told by her Musculoskeletal System

TABLE OF CONTENTS/OUTLINE

Anatomy of the Metatarsophalangeal Joints
Noncontrast MRI for Evaluation of the Metatarsophalangeal Joints
MR Arthrography for Detection of Tears of the Plantar Plate
MRI with Intravenous Contrast Media for Evaluation of the Plantar Plate and Adjacent Capsule
MRI for Detection of Injuries of the Interosseous Tendons
MR Imaging of Dislocation of the Metatarsophalangeal Joint
Technical Optimization of MRI for the Metatarsophalangeal Joints

MRI for Injuries of the Plantar Plate, Adjacent Joint Capsule, and Interosseous Tendons: Ten-year Experience and New Imaging Signs

MRI for Injuries of the Plantar Plate, Adjacent Joint Capsule, and Interosseous Tendons: Ten-year Experience and New Imaging Signs

MRI for Injuries of the Plantar Plate, Adjacent Joint Capsule, and Interosseous Tendons: Ten-year Experience and New Imaging Signs
Participants
Linda E. Chen, MD, Seattle, WA (Presenter) Nothing to Disclose
Christine M. Rehwald, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Sabah Servaes, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Felix S. Chew, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Alice S. Ha, MD, Seattle, WA (Abstract Co-Author) Grant, General Electric Company

TEACHING POINTS
After reviewing this exhibit, learners will acquire understanding of 1) imaging appearances of the musculoskeletal disorders affecting a woman's life from infancy to elderly years, 2) imaging evidence of musculoskeletal complications from pregnancy and childbirth, and 3) radiographic manifestations of treatments from diseases uniquely with female predominance.

TABLE OF CONTENTS/OUTLINE
1. Infancy and early childhood: developmental dysplasia of hip, McCune-Albright syndrome.


3. Childbearing:
   - Freiberg's infraction and Haglund syndrome, rheumatoid arthritis.
   - Pregnancy: transient osteoporosis of the hip, disc herniation and sciatica, deep musculoskeletal fibromatosis.
   - Childbirth: pubic symphysis diastasis or disruption, sacroccygeal dislocation and coccygodynia.
   - Post-partum: de quervain's, osteitis condensans illi.


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Felix S. Chew, MD - 2012 Honored Educator
Contemporary Problems in Arthritis Evaluation (An Interactive Session)

Participants
Donald J. Flemming, MD, Hershey, PA (Director) Royalties, Reed Elsevier

LEARNING OBJECTIVES
1) Describe the multimodality imaging features of common arthropathies. 2) Describe key imaging features that help distinguish one arthritis from another commonly confused entity. 3) Describe important clinical features that help establish the correct diagnosis of an arthropathy. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT
The purpose of this presentation is to discuss how to differentiate commonly confused arthropathies using a case based interactive format. The utility of multiple modalities and incorporation of clinical data in establishing a correct diagnosis will be reviewed.

Sub-Events
RC104A  Differentiating Rheumatoid Arthritis from Crystal Deposition Diseases

Participants
Donald J. Flemming, MD, Hershey, PA (Presenter) Royalties, Reed Elsevier

LEARNING OBJECTIVES
1) Describe the imaging features that differentiate rheumatoid arthritis and gout. 2) Describe the imaging features that differentiate rheumatoid arthritis and calcium pyrophosphate deposition disease.

ABSTRACT
Radiologists can have a tremendous impact on care of a patient suffering from an arthritis by confirming or establishing the correct diagnosis. Prevention of joint damage hinged on the correct diagnosis and therapeutic regimen. The purpose of this presentation is to review the imaging features that assist in differentiating rheumatoid arthritis from crystal deposition disease (gout and calcium pyrophosphate and hydroxyapatite deposition disease). A case based format will be used to demonstrate the critical radiographic, MRI, CT and ultrasound features that help establish the correct diagnosis.

RC104B  Differentiating Appendicular Inflammatory from Degenerative Arthritis

Participants
Thomas M. Link, MD, PhD, San Francisco, CA, (thomas.link@ucsf.edu) (Presenter) Research funded, General Electric Company; Research funded, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

LEARNING OBJECTIVES
1) To classify imaging studies of patients with arthropathies as inflammatory or degenerative. 2) To differentiate specific radiographic criteria of inflammatory arthropathies from those of degenerative osteoarthritis of the appendicular skeleton. 3) To identify findings that are found in both inflammatory and degenerative arthropathies, in particular in erosive osteoarthritis.

ABSTRACT
In general appendicular inflammatory arthropathies are characterized by loss of bone with juxta-articular osteopenia and erosive changes while degenerative arthritis shows increased bone formation with subchondral sclerosis and osteophytes. However, there is overlap as inflammatory arthropathies will eventually develop secondary degenerative changes and there is an erosive form of osteoarthritis (OA), which is typically found in older women. There are a number of criteria to differentiate OA and inflammatory arthropathies. These include location of abnormalities in the appendicular skeleton, which greatly helps to differentiate rheumatoid arthritis from OA (metacarpophalangeal/metatarsophalangeal joints in rheumatoid arthritis versus distal and proximal interphalangeal joints in OA) but not psoriatic arthritis and OA (distal and proximal interphalangeal joints in OA). Also inflammatory arthropathies and OA are both found at the radiocarpal, intercarpal and carpo-metacarpal joint 1. Differentiating erosive OA and psoriatic arthritis is a particular challenge as they both are erosive and may be found in the same locations. This lecture will present typical and more problematic cases of inflammatory and degenerative arthropathies, identify typical and overlapping findings and provide the attendees with a diagnostic approach to these entities.

RC104C  Differentiating Sarcoiditis from Its Mimickers

Participants
David C. Salonen, MD, Toronto, ON (Presenter) Consultant, AbbVie Inc; Consultant, Johnson & Johnson;

LEARNING OBJECTIVES
1) Discuss radiographic and MR criteria necessary for the diagnosis of sarcoiditis. 2) Describe the imaging features that differentiate inflammatory sarcoiditis from its mimickers.

ABSTRACT
Differentiating Ankylosing Spondylitis from Spinal Degenerative Disease

Participants
Robert G. Lambert, MBBCh, Edmonton, AB (Presenter) Research Consultant, Abbott Laboratories

LEARNING OBJECTIVES
1) Differentiate specific patterns of bone marrow abnormality on spine MRI from non-specific changes. 2) Describe the patterns of bone formation on spine radiography in middle-aged patients that distinguish between degenerative causes and spondyloarthritis. 3) Recommend which patients with spinal ossification need further imaging to distinguish between spondyloarthritis and DISH.

ABSTRACT
Diffuse idiopathic skeletal hyperostosis (DISH) is a degenerative disorder characterized by flowing ossification in the spine occurring primarily in the anterior longitudinal ligament, and to a lesser extent, in paravertebral tissues and the peripheral part of the annulus fibrosus. The ossification is usually most prominent along the anterior and right anterolateral aspects of thoracic vertebral bodies and, on lateral x-ray, radiolucency may be noted between new bone and the vertebral body. Current classification criteria for DISH require spinal ankylosis across 3 consecutive intervertebral discs and less extensive ankylosis may present a diagnostic challenge when criteria are not met. Concomitant disc degeneration is frequent but is less prevalent at fused levels. DISH may involve the sacroiliac (SI) joints but with relative preservation of articular cartilage. Spondyloarthritis (SpA) is a group of inflammatory disorders that involve the joints and entheses of the axial and peripheral skeleton and is typified by ankylosing spondylitis (AS). Spinal involvement is characterized by inflammation at the attachment of the annulus fibrosus. Osteitis may be seen in the form of erosion and/or sclerosis of the vertebral corner and "squaring" of the vertebral bodies on lateral views of the spine is caused by adjacent periosteal reaction. In the periphery of the annulus fibrosus, formation of syndesmophytes are seen as vertical bony spurring that may extend to bridge the disc causing ankylosis. The inflammatory process may result in ankylosis of the costotransverse, costovertbral, and facet joints and interspinous ligaments. These two conditions are easily distinguished when seen in their common presentation. However, patients with an older than usual onset of SpA over the age of 40 may be hard to distinguish from early DISH and disc degeneration is common at all ages regardless of both DISH and SpA. In many cases when the diagnosis is uncertain, further imaging, especially with MRI, may be useful to distinguish between these two entities. However while some patterns of MRI involvement are highly specific for one condition or another, often bone marrow abnormalities in the spine are non-specific and being able to distinguish between these patterns is of considerable diagnostic importance.

Monitoring Response to Disease Modifying Therapy

Participants
Eric Y. Chang, MD, San Diego, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the role of the radiologist in the management of arthropathies. 2) Compare the ability of different imaging modalities to detect inflammation and structural alteration. 3) Assess the response after disease modifying therapy according to established criteria.

ABSTRACT
Participants
Geetika Khanna, MD, MS, Iowa City, IA (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Differentiate normal and abnormal signal intensity patterns of abdominal structures in children. 2) Recognize normal developmental variants that can simulate abdominal pathology.

ABSTRACT
In pediatric neuroradiology, magnetic resonance imaging is used to assess central nervous system (CNS) disease in the infant, child, and teenager. This requires 1) an understanding of normal brain development and maturation from gestation through adolescence; 2) a technical mastery of the neuroimaging techniques that are used in evaluating brain diseases of childhood; and 3) an overall grasp of the imaging features of numerous brain pathologies, both acquired and congenital. This lecture will focus on the common MR imaging features of the normal pediatric brain and spine and will compare and contrast with MR imaging features in specific brain diseases and disorders of development.

Participants
Nancy A. Chauvin, MD, Philadelphia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the MR appearance of normal marrow conversion in the developing skeleton. 2) Identify common pediatric marrow pitfalls that might be mistaken for pathology. 3) Describe the MR appearance of common bone marrow abnormalities in children.

ABSTRACT
In pediatric neuroradiology, magnetic resonance imaging is used to assess central nervous system (CNS) disease in the infant, child, and teenager. This requires 1) an understanding of normal brain development and maturation from gestation through adolescence; 2) a technical mastery of the neuroimaging techniques that are used in evaluating brain diseases of childhood; and 3) an overall grasp of the imaging features of numerous brain pathologies, both acquired and congenital. This lecture will focus on the common MR imaging features of the normal pediatric brain and spine and will compare and contrast with MR imaging features in specific brain diseases and disorders of development.

Participants
Tina Y. Poussaint, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Assess MR features associated with normal brain and spine development and maturation. 2) Identify abnormal MR imaging features associated with specific brain diseases and disorders of development in childhood.

ABSTRACT
In pediatric neuroradiology, magnetic resonance imaging is used to assess central nervous system (CNS) disease in the infant, child, and teenager. This requires 1) an understanding of normal brain development and maturation from gestation through adolescence; 2) a technical mastery of the neuroimaging techniques that are used in evaluating brain diseases of childhood; and 3) an overall grasp of the imaging features of numerous brain pathologies, both acquired and congenital. This lecture will focus on the common MR imaging features of the normal pediatric brain and spine and will compare and contrast with MR imaging features in specific brain diseases and disorders of development.
 Participants
Ronald L. Arenson, MD, San Francisco, CA (Presenter) Nothing to Disclose

Sub-Events

PS12A  Report of the RSNA Research and Education Foundation

Participants
Burton P. Drayer, MD, New York, NY (Presenter) Advisor, Hologic, Inc

Abstract
The RandE Foundation - Our Future is Now This year marks the 100th anniversary of the RSNA's founding. As radiology looks toward the future, one wonders what the next 100 years will look like for our specialty and whether the central role of radiologists in healthcare will be sustained. Analogous to our clinical radiology mantra, if we are not at the radiology research table we will be on the menu. As a leading global force in radiology, the RSNA is poised to lead the specialty into the next century and exceed the incredible success of the past 100 years. The RandE Foundation will play a key role in radiology's future by continuing its support of inspiring investigators and those pursuing innovative approaches to education. To meet these research and education needs head-on, the Foundation launched Inspire-Innovate-Invest, The Campaign for Funding Radiology's Future® at last year's annual meeting. This bold campaign seeks to raise $17.5 million to fund grants in radiologic research and education, bridging the gaps in funding for promising investigators and educators. To date our campaign has been a success with individual, private practice and corporate donors generously pushing us to the mid-way point in our goal. There is still a long way to go. The future of our specialty depends on the commitment and generosity of each of us, the members of the imaging community. This year, the Foundation will fund 92 grants totaling $3.6 million. The RandE is funding 25% of our ever increasing number of excellent grant applications. While pleased with these achievements, imagine what the RandE Foundation could fund with additional support from all of us as radiology colleagues? During the meeting week, please take time to visit the RandE Foundation Booth, located on Level 3 of Lakeside Center to learn more about how you can be a part of the campaign and support the RandE Foundation and the future robustness of our specialty.

PS12B  Image Interpretation Session

Participants
Jonathan B. Kruskal, MD, PhD, Boston, MA (Presenter) Author, UpToDate, Inc
Donald P. Frush, MD, Durham, NC (Presenter) Nothing to Disclose
Bruce B. Forster, MD, Vancouver, BC (Presenter) Travel support, Siemens AG; Travel support, Toshiba Corporation;
Christine M. Glastonbury, MBBS, San Francisco, CA (Presenter) Author with royalties, Reed Elsevier
Michelle M. McNicholas, MD, Dublin, Ireland (Presenter) Nothing to Disclose
Melissa L. Rosado De Christenson, MD, Kansas City, MO (Presenter) Author, Thieme Medical Publishers, Inc; Author, Reed Elsevier; Author, American Registry of Pathology; Author, Oxford University Press; ; ;
Jorge A. Soto, MD, Boston, MA (Presenter) Nothing to Disclose

Honored Educators

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Melissa L. Rosado De Christenson, MD - 2012 Honored Educator
Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator
Jonathan B. Kruskal, MD, PhD - 2012 Honored Educator
RSNA Diagnosis Live™: 'Bo you don't know Didley' - Test Your Diagnostic Skills at the Crack of Dawn

Monday, Nov. 30 7:15AM - 8:15AM Location: E451B

CA, GI, HN, MK, NR

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Adam E. Flanders, MD, Penn Valley, PA (Presenter) Nothing to Disclose
Christopher G. Roth, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA, (sandeep.deshmukh@jefferson.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
**Case-based Review of Magnetic Resonance (An Interactive Session)**

Monday, Nov. 30 8:30AM - 10:00AM Location: S100AB

**LEARNING OBJECTIVES**

1) Be familiar with the MRI appearance of common musculoskeletal derangements of the hip. 
2) Develop a differential diagnosis for musculoskeletal soft tissue tumors based on MRI appearance. 
3) Distinguish between common benign and malignant liver neoplasms. 
4) Be familiar with the typical MRI appearance of select female pelvic disorders.

**ABSTRACT**

This session will help attendees recognize and manage select, commonly encountered musculoskeletal and abdominopelvic abnormalities based on their MRI appearances using a case-based, interactive format.

**Sub-Events**

**MSCM21A  Musculoskeletal MRI of the Hip and Pelvis**

Participants
John R. Leyendecker, MD, Dallas, TX (Director) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

**MSCM21B  MRI of Soft Tissue Masses of the Extremities**

Participants
Kirkland W. Davis, MD, Madison, WI, (kdavis@uwhealth.org) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Distinguish characteristic extremity soft tissue masses on the basis of signal characteristics, such as high signal on T1-weighted images or low signal on all sequences.

**ABSTRACT**

**MSCM21C  MRI of the Liver**

Participants
Nicole M. Hindman, MD, New York, NY, (Nicole.Hindman@nyumc.org) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Recognize and analyze benign but unusual liver lesions. 
2) Analyze uncommon presentations of liver lesions. 
3) Recognize neoplastic mimics of benign lesions in the liver (eg, a colon metastasis mimicking a hemangioma).

**ABSTRACT**

This session will cover common and uncommon presentations of liver lesions on several modalities (ultrasound, CT and MRI). A brief interactive review of common, but atypical presentations of both benign and malignant liver lesions will be presented. Malignant mimics of benign liver lesions will also be shown, with features that should be analyzed in order to better characterize the lesion, and appropriately raise concern (eg, for a metastasis or intrahepatic cholangiocarcinoma instead of a benign hemangioma). Recent advances in liver lesion characterization will be covered.

**MSCM21D  MRI of the Female Pelvic Organs**

Participants
Christine O. Menias, MD, Scottsdale, AZ, (menias.christine@mayo.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Honored Educators**

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Christine O. Menias, MD - 2013 Honored Educator
Christine O. Menias, MD - 2014 Honored Educator
Christine O. Menias, MD - 2015 Honored Educator
**RC204**

**Muscloskeletal Series: Knee and Hip MR Imaging**

Monday, Nov. 30 8:30AM - 12:00PM Location: E451B

**Participants**
Lynne S. Steinbach, MD, San Francisco, CA, (lynne.steinbach@ucsf.edu) (*Moderator*) Nothing to Disclose
Miriam A. Bredella, MD, Boston, MA, (mbredella@mgh.harvard.edu) (*Moderator*) Nothing to Disclose

**LEARNING OBJECTIVES**

**ABSTRACT**

1) Recognize common causes of false positives on MRI of the knee including misinterpretation of normal structures and normal variants, such as the dorsal defect of the patella. 2) Review causes of false negatives on MRI of the knee that may be undetected due to lack of recognition or that may look normal over time, such as a chronic cruciate ligament tear.

**ABSTRACT**

MRI is highly accurate for evaluation of the knee joint. This lecture will emphasize common pitfalls and pearls to get around them when evaluating the knee with MRI. Some anatomic structures and normal variants can simulate an abnormality of the menisci, ligaments, cartilage, bone and surrounding soft tissues of the knee on MRI. In addition there are some abnormalities that can be missed or misinterpreted.

**RC204-01  Pitfalls in Knee MRI Interpretation**

**Participants**
Lynne S. Steinbach, MD, San Francisco, CA, (lynne.steinbach@ucsf.edu) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

**ABSTRACT**

MRI is highly accurate for evaluation of the knee joint. This lecture will emphasize common pitfalls and pearls to get around them when evaluating the knee with MRI. Some anatomic structures and normal variants can simulate an abnormality of the menisci, ligaments, cartilage, bone and surrounding soft tissues of the knee on MRI. In addition there are some abnormalities that can be missed or misinterpreted.

**RC204-02  The Anterolateral Ligament of the Knee: A Regular Ligament or Our Imagination? Correlation of MR Imaging with Anatomical Findings**

**Participants**
Enver G. Tahir, MD, Hamburg, Germany (*Presenter*) Nothing to Disclose
Christoph A. Berliner, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Sinef Yarar, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Georg Luers, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Murat Karul, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Jin Yamamura, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Recently, evidence has been accumulating for the existence of a previously unknown structure at the anterolateral aspect of the human knee named anterolateral ligament (ALL). The aim of this study was to evaluate the visibility and to describe the anatomic features of the ALL using magnetic resonance imaging (MRI) and to correlate the results with gross anatomical findings.

**METHOD AND MATERIALS**

16 human knees were obtained from cadavers (4 male, 9 female) at a mean age of 84.3 ±5.2 years. All specimens were examined with plain film radiography to exclude advanced degenerative arthrosis, prior osseous injuries as well as joint replacement. Subsequently, MRI scans were performed with a 3 Tesla machine (Ingenia, Philips). Two musculoskeletal radiologists independently reviewed coronal and axial T1- and proton density-weighted images to assess the visibility of the ALL. In all 16 knees the lateral supporting structures were carefully dissected by an orthopedic surgeon and an anatomist to identify the course and anatomy of the ALL as well as its length and thickness.

**RESULTS**

On the basis of MR imaging a consistent structure correspondent to the ALL was identified in 11 knees (68%). On anatomical dissection the ALL was found in 13 knees (81%). It originated at the lateral femoral epicondyle and its proximal part was blended with the lateral collateral ligament (LCL) making it difficult to distinguish these two structures. The ALL was distally separate from the LCL and ran obliquely to insert on the lateral tibial plateau between Gerdy’s tubercle and the fibular head. Measurements of a completely visible ALL on anatomic dissections revealed an average proximal length of 42.8 ±4.6 mm and a distal length of 34.3 ±10.8 mm, whereas its width was 6.46 ±2 mm.

**CONCLUSION**

MRI of the knee was accurate and sensitive in the identification of the intact ALL. It appeared as a thin black structure on T1 weighted sequences and was best visualized on coronal images. Information concerning this structure may be crucial with respect to the diagnosis and understanding of knee pathologies.

**CLINICAL RELEVANCE/APPLICATION**

The evidence for the existence of the ALL has been correlated with anatomical dissections.
The ALL is believed to be responsible for the Segond fracture and its rupture has been associated with anterolateral rotational knee instability. MRI imaging may provide valuable information about the ALL.

**RC204-03  Anterolateral Ligament Injury in Patient with Acute ACL Tears on MRI: Prevalence, Patterns and Relationships with Tibial Contusions**

**PURPOSE**
The anterolateral ligament (ALL) of the knee is believed to be involved in maintaining rotatory stability of the knee, may be injured with the anterior cruciate ligament (ACL) tear during pivot shift injuries and may be accountable for failed ACL repairs. We sought to describe the incidence and patterns of ALL injury in patients with acute ACL tears, and investigate if there is a relationship with various bone contusions, meniscal tears and posterolateral injuries.

**METHOD AND MATERIALS**
Knee MR examinations of 81 patients with acute ACL tears were retrospectively reviewed by two musculoskeletal radiologists to assess the ALL: visualization, location of tibial insertion, sprain and presence of an anterolateral tibia insertional bone contusion. Additional bone contusions in the posteroomedial, posterolateral and anteromedial tibia and lateral femoral condyle were noted, as well as meniscal tears and posterolateral injuries (popliteus tendon and fibular collateral ligament [FCL]). Statistical analysis for relationships of these findings with ALL injuries was obtained utilizing the Pearson correlation and Chi2 tests.

**RESULTS**
ALL injury, including sprain and/or an anterolateral tibia traction contusion, was seen in 49/81 (60%) (34/81 [42%] and 32/81 [40%], respectively), with an avulsion fracture in 3/32 (9%). Anteromedial and posterolateral tibial contusions were significantly more common in patients with ALL injury (p=0.004 and p=0.006, respectively). The anterolateral tibial traction contusion was characteristically subcortical, elongated (mean size (mm) 10.7CC x 12.7AP x 4.6TV), and involved the middle anteroposterior third of the tibia. There was correlation with posterolateral injury (p=0.046) and medial meniscal tears (32/81, p=0.049). There was no relationship between lateral meniscus tear, posterolateral tibial or lateral femur bone contusion and ALL injury.

**CONCLUSION**
ALL injury is present in more than 50% of ACL tears. It is specifically associated with anteromedial and posterolateral tibial contusions, and some demonstrate a characteristic anterolateral traction contusion.

**CLINICAL RELEVANCE/APPLICATION**
ALL injury is common on MRIs of acute ACL tears. Anteromedial and posterolateral tibia contusions are suspicious and anterolateral, elongated subcortical tibia contusion and ALL sprain should be assessed.

**RC204-04  Distal MCL Tears of the Knee: MRI Features of Stener-like Lesions**

**PURPOSE**
To analyze the MRI characteristics of distal MCL tears, without and with displacement superficial to the pes anserinus (Stener-like lesion [SLL]).

**METHOD AND MATERIALS**
In this IRB-approved study, MRI examinations of the knee at three institutions were selected which showed partial or complete tears of the (superficial) MCL centered distal to the joint line. MRI examinations were evaluated independently by two musculoskeletal radiologists for: a SLL of the distal MCL; coexistent tears of the meniscotibial and meniscofemoral ligaments; a wavy contour to the more proximal MCL; the vertical distance of the stump from the medial joint line; and the transverse distance of the stump from the medial tibial cortex. Additional co-existent knee injuries also were recorded.

**RESULTS**
The study included 32 patients (median age: 27 years; interquartile range 18 years). A SLL of the MCL was identified in 11 of 32 cases. The proximal stump margin was located significantly (p<0.01, Mann Whitney U) more distal in cases with a SLL (mean=35 mm, sd=11 mm), as compared to without a SLL (mean=16 mm, sd=15 mm). The incidence of ACL tear, PCL tear, meniscotibial/meniscofemoral ligament tear, and lateral compartment osseous injury was high in cases with a SLL (91%, 36%, 73%, and 91%, respectively), but not significantly different (p>0.10, Fisher's exact test) from cases without a SLL (81%, 33%, 57%, and 91%, respectively). The MCL had a wavy appearance in 82% of cases with a SLL, and in 62% without a SLL.

**CONCLUSION**
A SLL of the MCL should be considered in the setting of a high-grade, distal MCL tear, particularly when there is a wavy appearance to the MCL. These lesions are accompanied very frequently by tears of the ACL and meniscotibial/meniscofemoral ligaments.

**CLINICAL RELEVANCE/APPLICATION**
The MCL had a wavy appearance in 82% of cases with a SLL, and in 62% without a SLL.
A SLL of the distal MCL is important to recognize for appropriate treatment and operative decision making.

**Purpose**

The aim of our study was to evaluate the value of weight-bearing (WB)-MRI compared to standard-MRI in unmasking PLC structures involvement to determine a PLI.

**Method and Materials**

We prospectively analyzed 200 patients positive for an acute ACL injury, only 100 of them with suspicion of a PLI. All patients underwent a dedicated MRI in supine and WB position with knee flexion of 12°-15°. We evaluated knees for 3 direct signs of ACL injury (discontinuity, ACL altered morphology and deflection) and for 4 indirect signs (bone bruise, anterior tibial translation, uncovered lateral meniscus and hyperbuckled posterior cruciate ligament (PCL)). We evaluated the involvement of PLC capsuloligamentous structures. All patients underwent arthroscopy.

**Results**

Among the direct signs we obtained that ACL deflection resulted the most statistically significant (p<0.004); among the indirect signs the anterior tibial translation was the most statistically significant (p<0.0001) followed by the uncovered lateral meniscus (p<0.005). Finally we evaluated the involvement of PCL capsuloligamentous structures (antero-lateral and postero-medial popliteo-meniscal ligaments): both the ligaments were involved in 65/89 of the cases instead of only the inferior one was involved in 24/89 of the cases. Arthroscopy confirmed ACL tear with diagnosis of PLI in 89% of cases. The 100 patients with no clinical suspicion of PLI didn't show modifications of signs during the standard and WB-MRI.

**Conclusion**

The study discovers the value of WB-MRI in recognizing the most sensitive direct and indirect signs of ACL injury and to diagnose a PLI involvement, leading patients to the right surgical treatment.

**Clinical Relevance/Application**

The diagnosis of the PLI is always clinical however there is no a pre-operative specific test to diagnose it. The added value of the weight-bearing MRI is to provide further information in unmasking direct/indirect signs of ACL injury negative at standard-MRI. This may be very helpful for the orthopedic surgeon in the choice of possible treatment and to avoid an ACL graft failure.

**Learning Objectives**

1) Understand the anatomy of the posterolateral corner of the knee. 2) Realize the importance of the posterolateral corner in injury of the knee. 3) Be able to recognize major and minor posterolateral corner injury on MRI.

**Pitfalls in Hip MRI Interpretation**

After highlighting relevant anatomy, we review the current indications and techniques used for meniscus surgery, and focus on MRI interpretation of the postoperative meniscus, including recurrent tears and outcomes/complications.
LEARNING OBJECTIVES
1) Develop a search pattern in the evaluation of the painful hip. 2) Identify common pitfalls in hip MRI interpretation. 3) Describe different features for conditions affecting the hip. 4) Differentiate between normal variants and pathology of the hip.

ABSTRACT

Relevant hip anatomy will be reviewed, followed by imaging features of intra-articular, internal and osseous pathology in the patient with the painful hip. Interpretive imaging pitfalls of these structures will be discussed.

RC204-09 Can MRI Predict a Future Bucket Handle Type Meniscus Tear in Patients with Recent Knee Trauma and ACL Injury?

METHOD AND MATERIALS

A PACS and report database was searched for MRI knee examinations describing a medial BHMT from 2006 to 2013. These exams were then screened for the availability of a prior MRI performed after a trauma with no BHMT. The prior MRI was reviewed for presence of a meniscal tear or lesion border line for a tear, tear configuration (oblique, horizontal, vertical, or complex), tear location (anterior horn, body, and/or posterior horn), tear zone (red, white, and/or pink), tear extension to articular surfaces of the meniscus (inferior, superior or both) and the presence of concomitant anterior cruciate ligament pathology (disruption or reconstruction). The time interval between the initial MRI and the BHMT MRI was recorded, as was patient age and gender.

RESULTS

931 MRIs with reported BHMT yielded 39 subjects with prior MRI. Of these, only 7/39 (17.9%) had no clear meniscus tear on the initial study and 6/7 had edema type signal at the posteromedial margin of the medial meniscus. Of the 32/39 (82.1%) with prior meniscal tears; 27/32 (84.4%) were vertical or complex with a vertical component, 4/32 (12.5%) were oblique, and 1/32 (3.1%) were horizontal. All of the prior meniscal tears involved the posterior horn while 10/32 (31.2%) also involved the meniscal body. The red zone was most often involved (28/32, 87.5%), while the white and pink zones were involved in 12/32 (37.5%) and 15/32 (46.8%) respectively. Concomitant ACL pathology was common on the initial exams, seen in 26/39 (66.6%). Of the 26 patients with ACL pathology, 16 had an active ACL tear and 10 had a prior ACL reconstruction. 28/32 (87.5%) of the initial meniscus tears including all vertical tears involved both articular surfaces.

CONCLUSION

In the setting of knee trauma and ACL injury, MR findings of a vertical medial meniscus tear involving the red zone and both articular meniscal surfaces should raise concern for the potential evolution of a BHMT.

CLINICAL RELEVANCE/APPLICATION

A non displaced peripheral vertical medial meniscal tear is an important observation on a posttraumatic knee MRI. Orthopedists should consider repair to prevent the evolution of a BHMT.

RC204-10 Hip MR Arthrography: Are We Underdiagnosing Laxity Pre-operatively?

METHOD AND MATERIALS

After obtaining IRB approval, we identified 57 consecutive patients (36 women, 21 men) undergoing first hip MR arthrography and then arthroscopy by a single hip arthroscopist, within a maximum of 10 months (excluding patients with hip hardware, fractures, or tumors). The original MR report was reviewed for the preoperative diagnosis of laxity. An MSK radiologist and an MSK fellow blinded to surgical results then re-reviewed, by consensus, the MR arthrograms for 2 morphologic findings that have been associated with hip laxity: Widening of the anterior hip joint recess (>5 mm) and thinning of the adjacent joint capsule (<3 mm). Measurements were made on an axial T1-weighted image without fat saturation at the level of the anterior capsule insertion onto the greater
None of the 57 MR reports described the findings related to laxity. Logistic regression was performed using clinical laxity as the dependent variable and gender, age, and MR findings of laxity scored as independent variables. Clinical laxity was much more common in women (26 women, one man). It was also more common in older patients. Statistically significant associations were noted between clinical laxity and gender (odds ratio for men = 0.009, p = 0.0001) and the presence of both MR findings of laxity (odds ratio = 11.1, p = 0.039).

CONCLUSION

Hip laxity is commonly underdiagnosed on pre-operative MR reports, compared with exam under anesthesia. We were able to confirm an association between clinical laxity and the MR findings of anterior recess widening and anterior capsular thinning.

CLINICAL RELEVANCE/APPLICATION

Atraumatic hip instability is increasingly recognized as a cause of hip pain that is potentially treatable, but difficult to diagnose preoperatively. MR may help identify patients with laxity, thus influencing surgical management.

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Michael L. Richardson, MD - 2013 Honored Educator
Michael L. Richardson, MD - 2015 Honored Educator

PURPOSE

The aims of this study were to test useful parameters for ischiofemoral impingement (IFI) on both supine and standing anteroposterior hip radiographs, and to suggest optimal cut-off points for detection of IFI on radiograph.

METHOD AND MATERIALS

We performed a retrospective study for all patients who had a clinical history of hip pain. All hip joints with quadratus femoris muscle (QFM) edema characterized by increased signal intensity on axial FatSat T2-weighted MR images were selected as a IFI patient group, and an age- and sex-matched control group was created from the same cohort by propensity-score matching. Two readers independently measured the parameters, including ischiofemoral space (IFS), quadratus femoris space (QFS) and hamstring tendon area (HTA) on MR images. The ischiofemoral distance (IFD) and femur neck shaft angle (NSA) were also measured on radiographs. Differences in each parameters between the two study groups were assessed by using the Mann-Whitney U test. Interobserver agreement was quantified by using the intraclass correlation coefficient. The area under the ROC curve (AUC) was calculated as a measure of discriminative ability. Youden's J statistic was used to select the optimum cut-off points for each parameter on radiograph.

RESULTS

A total of 30 patients with QFM edema (44 hip joints, age: 54.8±11 years) were included in the IFI patient group. A total of 88 patients without QFM edema (88 hip joints, age: 51.8 ± 13.4) were selected as control group from a cohort after propensity score matching. IFS, QFS, NSA and IFD showed statistically significant differences between two groups (p < 0.05). IFS, QFS and IFD showed almost perfect interobserver agreements (r > 0.8). IFDs showed good discrimination abilities (AUC > 0.80). Optimal cut-off points for IFD by reader 1 were 19.9 mm and 16.2 mm on supine radiograph and standing radiograph, respectively. Optimal cut-off points for IFD by reader 2 were 21.1 mm and 17.0 mm, respectively.

CONCLUSION

IFDs on both supine and standing hip radiographs showed good diagnostic performances for detection of IFI. It could be used as a good screening tool with optimal cut-off points.

CLINICAL RELEVANCE/APPLICATION

The measurements of ischiofemoral distances on both supine and standing hip radiographs are useful screening tool with good diagnostic performances for detection of ischiofemoral impingement.
PURPOSE
To validate the use of 3D MRI in volumetric computation of muscle wasting To demonstrate the role for 3D MRI in evaluating diseased muscles around hip replacements

METHOD AND MATERIALS
We have applied a novel automated segmentation propagation framework to the MR images of 18 patients with unilateral metal on metal hip replacements. The MR images were manually segmented into the following muscles: Gluteus maximus, Gluteus minimus, Iliopsoas and Tensor Fasciae Latae. MR images were bias-field corrected. The scans were divided in half to create two databases, healthy and diseased, which were processed separately. Each MR image in the database was affinely registered to all the other images using a block matching algorithm and aligned to a common space. We obtained an average matrix for the alignment of images in the database using least trimmed square regression. Consensus segmentation was achieved using similarity and truth estimation algorithm for propagated segmentations (STEPS). The proposed framework was assessed using a leave-one out validation approach. This was used to quantify a clinically relevant imaging biomarker.

RESULTS
The MR images of 18 patients (11 female, 7 male) aged 64 ± 15yrs underwent novel automated segment propagation. The leave-one out cross validation framework assessing the influence of non-rigid registration and label fusion parameters gave the average Dice score for healthy hip muscles is 0.864 (range 0.804-0.931). The average Dice score for pathological hip muscles is 0.827 (range 0.753-0.899).

CONCLUSION
The accuracy of the proposed automated framework was verified by leave one out cross validation. The values obtained for the average are promising given that only 17 MR images are in the database. We would expect these scores would to rise with a larger database of images. Future work would involve the expansion of this database in order to define more variability and obtain more accurate automated segmentation.

CLINICAL RELEVANCE/APPLICATION
3D MRI, a technique applied successfully in brain imaging, offers a novel way to monitor the muscle disease formation and progression in patients with hip arthroplasties. This automated segmentation framework can be used to verify volume discrepancies in unilateral hip arthroplasty patients which is currently done manually. This technique will aid patient monitoring and surgical planning.

ABSTRACT
Relevant extra-articular hip anatomy will be reviewed, followed by MRI findings of common pathology of tendons, muscles, and bursae around the hip. Pathomechanisms and imaging findings of extra-articular hip impingement syndromes will be discussed.

Participants
Miriam A. Bredella, MD, Boston, MA, (mbredella@mgh.harvard.edu) (Presenter) Nothing to Disclose
LEARNING OBJECTIVES
1) To review the nomenclature and criteria for the diagnosis of juvenile idiopathic arthritis (JIA) in children. 2) To recognize the sites in children commonly affected by JIA. 3) To illustrate the spectrum of abnormalities identified with magnetic resonance imaging in children with JIA.

ABSTRACT

PURPOSE
The value of subclinical synovitis on magnetic resonance imaging (MRI) in clinically inactive patients with juvenile idiopathic arthritis (JIA) is yet to be unraveled. This study was performed to determine whether (dynamic) contrast-enhanced MRI parameters of a previously affected target joint in patients with clinically inactive JIA can predict a flare of joint inflammation during 2-year follow-up.

METHOD AND MATERIALS
Thirty-two JIA patients with clinically inactive disease at the time of MRI of the knee were prospectively included. Dynamic contrast-enhanced (DCE) MRI provided both descriptive measures and time-intensity-curve shapes, representing functional properties of the synovium. Conventional MRI outcome measures included validated scores for synovial hypertrophy, bone marrow edema, cartilage lesions and bone erosions. During a 2-year period the patients were examined at regular time points and clinical flares were registered.

RESULTS
MRI analysis revealed synovial hypertrophy in 13 (39.4%) of the clinically inactive patients. Twelve patients (37.5%) had at least one flare during 2-year clinical follow-up. Median time-to-flare was 0.68 years (IQR 0.18-1.97) and 50% of the flaring patients did so within the first 6 months (Figure 1). Persistently inactive and flaring patients differed significantly in the maximum enhancement of the DCE-MRI (p<0.05), whereas no difference was found between these two groups in any of the baseline scores of conventional MRI.

CONCLUSION
Our prospective clinical follow-up study indicates that the assessment of ‘maximum enhancement’ upon DCE-MRI may be able to predict a clinical flare within 2 years in inactive JIA patients. In the future, functional imaging biomarkers, such as DCE-MRI can be combined with serum markers or gene profiling data, leading to the construction of a predictive model to more precisely decide about treatment strategies in any individual patient.

CLINICAL RELEVANCE/APPLICATION
The presence of a relatively high maximum enhancement on dynamic contrast-enhanced MRI of the knee in clinically inactive patients with juvenile idiopathic arthritis indicates a risk of flaring.
**RC213-03**  
**Periosteal Entrapment in Salter-Harris Injuries: Too Much on the Plate**

**Monday, Nov. 30 9:00AM - 9:10AM Location: N230**

**Participants**
- Peter H. Van Geertruyden, MD, Fort Belvoir, VA (Presenter) Nothing to Disclose
- Patent agreement, AprioMed AB Consultant, Zimmer Holdings, Inc
- Adam C. Zoga, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
- Timothy G. Sanders, MD, Keswick, VA (Abstract Co-Author) Nothing to Disclose
- Jana M. Crain, MD, Atherton, CA (Abstract Co-Author) Nothing to Disclose
- Brendan T. Doherty, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To present a series of Salter-Harris injuries with periosteal entrapment, to better understand incidence and distribution, appearance and potential complications with regard to healing.

**METHOD AND MATERIALS**
Two musculoskeletal radiologists retrospectively reviewed 142 MRI exams with Salter-Harris injuries from 2007 to present for the presence of periosteal entrapment. Evaluation included Salter-Harris grade, location, presence of periosteal entrapment, and degree of entrapment measured in distance extending within the physis. Available follow-up imaging findings and clinical evaluations were recorded.

**RESULTS**
Of 144 Salter-Harris injuries on MRI, 59 cases were type I injuries, 48 cases were type 2 injuries, 20 cases were type 3 injuries, 14 cases were type 3 injuries, and 3 cases were type 5 injuries. The most common location for type I injuries was the distal fibula. The most common location for type 2 injuries was the distal radius. Type 3 and 4 Salter-Harris injuries showed no particular location preference. Of the 144 cases, 96 cases were in boys and 48 in girls. Average age of boys was 13 years, 9 months. The average age for girls was 12 years, 4 months.

**CONCLUSION**
Periosteal entrapment is observed in 7% of Salter-Harris injuries by MRI; entrapment is an under-reported phenomenon in current literature. In our series periosteal entrapment occurred most commonly at the distal tibia and fibula. Continued follow-up will reveal whether premature physeal arrest/growth disturbance is associated with periosteal entrapment.

**CLINICAL RELEVANCE/APPLICATION**
To make aware the frequency and potential implications of periosteal entrapment in Salter Harris fractures.

**RC213-04**  
**Plastic Bowing Fractures of the Pediatric Forearm: Evaluation of a Novel Computer Aided Method for Detection**

**Monday, Nov. 30 9:10AM - 9:20AM Location: N230**

**Participants**
- Uygar Teomete, MD, Miami Beach, FL (Presenter) Nothing to Disclose
- Yuwei Zhou, Coral Gables, FL (Abstract Co-Author) Nothing to Disclose
- Ozgur Dandin, MD, Bursa, Turkey (Abstract Co-Author) Nothing to Disclose
- Weizhao Zhao, Coral Gables, FL (Abstract Co-Author) Nothing to Disclose
- Taner Dandinoglu, Bursa, Turkey (Abstract Co-Author) Nothing to Disclose
- Onur Osman, PhD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
- Ulas Bagci, PhD, MSc, Orlando, FL (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
1. To develop a computer aided diagnosis (CAD) system for detection of plastic bowing fractures of the pediatric forearm and 2) to compare its feasibility with respect to the radiologists' interpretation.

**METHOD AND MATERIALS**
Following IRB approval, we retrospectively analyzed the forearm radiographs of the patients presenting to the pediatric emergency room following trauma. We included a total of 55 pediatric patients from all age groups. We used morphological operations to extract the forearm diaphyseal features. In geometry, the radius of curvature, R, is a measure of the radius of the circular arc which best approximates the curve at that point. Along with the border of the bone, at every point, the more “bending” of the curve, the smaller of the radius of curvature; the “flatter” of the curve, the bigger of the radius of curvature. Average of R increases with increased bowing level. Curvature of the radial and ulnar diaphyses were calculated for the normal patients with normal interpretation and for the patients with plastic bowing fracture. Leave one out cross validation scheme was used for avoiding bias in our evaluations. Results were compared with the radiologist's interpretation. t-test was used to determine statistical significance level.

**RESULTS**
Curvature values were obtained from our CAD method in the training step. With a sensitivity of 80% in detecting plastic bowing fractures, we recorded 92% specificity. When compared to radiologists’ conventional readings, we did not find significant differences between the proposed method and the radiologists’ reading using t-test (p>0.05).

**CONCLUSION**
The proposed automated computer aided detection method can be used as a second opinion to aid the radiologist’s decision making by highlighting the suspicious regions for plastic bowing fracture. To best of our knowledge, this is the first attempt towards automatizing quantitative evaluation of pediatric buckle fractures from radiographs.
**RESULTS**

Intra- and inter-reader agreement was very good (Cohen's kappa inter-reader = 0.77 and intra-reader = 0.82 and 0.84). The relative prevalence of GRLs in the low-risk groups was 38% (SD 8%, reader 1 = 17/53, reader 2 = 23/53) vs. 71% (SD 7%, reader 1 = 16/21, reader 2 = 14/21) in the high-risk group (p < 0.001, odds ratio 4.1, 95% CI 1.8 to 9.8).

**CONCLUSION**

GRLs are encountered at a significantly higher rate in infants at high- vs. low-risk for abuse. This difference may reflect the response of enchondral ossification to intermittent stresses associated with abusive events. However, since healing classic metaphyseal lesions may appear as radiodense transverse metaphyseal bands, some of the apparent GRLs in the high-risk group may reflect the residua of inflicted metaphyseal injury.

**CLINICAL RELEVANCE/APPLICATION**

GRLs may carry special significance when encountered in infants with suspected abuse. The possibility that some apparent GRLs may in-fact reflect healing occult metaphyseal injuries deserves further study.

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**RC213-06 Definition of a Scoring System for Assessment of Skeletal Age Using MRI of Hand and Wrist in Healthy Males and Females Children: Gender Differences**

**PURPOSE**

Magnetic Resonance Imaging (MRI) of hand and wrist is a radiation free tool used to create a gender specific scoring system method for the skeletal age (SA) estimation in the healthy pediatric population.

**METHOD AND MATERIALS**

96 healthy young male (chronological age (CA )1y6mo to 19y) and 108 females (CA range 4y to 19y) were enrolled. 9 bones of the wrist and hand were analyzed at different stages of the skeletal maturation detecting different pattern of growth among tubular and carpal bones based on several anatomic features of the cartilaginous and osseous component . Two operators first in consensus and after 6 months blinded from CA established a MRI scoring system. Correlation between CA and MRI bone age estimation was determined with Pearson coefficient (R2). Spearman's correlation coefficient (r) was used to analyze each carpal and tubular bones stages development.

**RESULTS**

A significant linear correlation (R2) between MRI bone age estimation and CA was demonstrated in males (R2 = 0.976, A operators in consensus, R2 = 0.978 B first operator in the double-blind, R2 = 0.977 C second operator in double-blind) and females (R2 = 0.9694, operators in consensus, R2 = 0.9751 B first operator double-blind, R2 = 0.9710 C second operator in double-blind). Radius and Ulna showed a stronger correlation with the skeletal age in both males and (Radius r = 0.96; Ulna r = 0.963, p = <0.0001) females (Radius r = 0.975, Ulna r = 0.96372 p <.05000). A good linear correlation was observed (males R2=0.96; females R2 = 0.9472) between the sum of scoring system assigned for each subject and the CA in years. The growth curve resulting from the correlation...
CONCLUSION
The score system for MRI bone age estimation can be potentially used as a clinical tool to evaluate skeletal development. Males and females have patterns of maturation corresponding to a different clinical speed of growth. The MRI score system shows specific anatomical details characterizing the pubertal age when between the sexes there is a gap of about 2 years.

CLINICAL RELEVANCE/APPLICATION
Bone age estimation is performed in pediatric patients with growth failure and advanced or delayed puberty maturation mainly covering the clinical areas of endocrine, skeletal and metabolic diseases.

RC213-08  Imaging of Slipped Capital Femoral Epiphysis: From Early Diagnosis to Late Sequelae

LEARNING OBJECTIVES
1) Recognize imaging findings of SCFE using radiographs, MR, CT, and US. 2) Understand surgical management and normal post-operative appearance of SCFE. 3) Recognize imaging findings of immediate and delayed post-operative complications of SCFE.

PURPOSE
To determine if rickets is present in infant homicides with classic metaphyseal lesions (CMLs) and other skeletal injuries.

METHOD AND MATERIALS
This study was exempt from the institutional human subjects board review because the infants were all deceased. An archival review (1984-2012) was performed of the radiologic and histopathologic findings of 46 consecutive infant fatalities referred from the state Medical Examiner's Office for the evaluation of possible child abuse. Thirty infants with distal femoral histologic material were identified. Additional inclusion criteria were: 1) The medical examiner determined that the infant had sustained a head injury and that the manner of death was a homicide; 2) At least one CML was evident on skeletal survey; 3) CMLs were confirmed at autopsy; and 4) Non-CML fractures were also present. Nine infants (mean age 3.9 months, range: 1-9 months) were identified. Two pediatric radiologists independently reviewed the skeletal surveys for rachitic changes at the wrists and knees. A bone and soft tissue pathologist reviewed the distal femoral histologic sections for rickets.

RESULTS
There were no radiographic or pathologic features of rickets in the cohort.

CONCLUSION
Our findings provide no support for the view that the CML is due to rickets. Rather, they strengthen a robust literature that states that the CML is a traumatic injury commonly encountered in physically abused infants.

CLINICAL RELEVANCE/APPLICATION
This work confirms the traditional view that the classic metaphyseal lesion is a fracture encountered in abused infants rather than a manifestation of rickets. The classic metaphyseal lesion is a characteristic fracture in child abuse and should be reported as such.
The correlation between age and pre-intervention imaging findings and the need for reintervention. This needs further evaluation. There is no biomechanical muscle imbalance. Variables leading to a 42% rate of re-intervention in children who underwent closed reduction may be operator dependent or be related to extra-articular causes such as femoral version and could have been determined on the fluoroscopic images alone. Variables leading to a 42% rate of re-intervention in children who underwent closed reduction may be operator dependent or be related to extra-articular causes such as femoral version and could have been determined on the fluoroscopic images alone. Out of 19 hips that underwent closed reduction, 8 (42%) needed reintervention. Out of 23 hips that underwent open reduction, 1 (4%) needed reintervention but this was no correlation between age (P value=0.12), acetabular angle (P value=0.46), degree of lateral displacement (P value=0.82) and degree of superoinferior displacement (P value=0.54) and the need for re-intervention. Out of 103 (83%) studies were positive by both radiologists. The most common pathologies that were identified by rad1 and rad2 were: hip effusion (63% and 57%), osteomyelitis (58% and 59%) and myositis (37% and 38%). 46% and 54% patients had more than one pathology. Using the full MR as the gold standard, the STIR-only series yields a sensitivity and specificity of 94% and 83% (rad1) and 94% and 67% (rad2). In 42% and 54% of the 97 true positive STIR-only studies, inconsistencies were found on the full MR scans, the most common of which were missed osteomyelitis (20% and 21% by rad1 and rad2) and myositis (7% and 13% by rad1 and rad2). The readers agreed on 111 (87.4%) coronal STIRs (95 abnormal; 16 normal), Kappa statistic is moderate, 0.59.

Conclusions
Coronal STIR has high sensitivity (94%) with good interobserver agreement in detecting pathology in children with acute hip pain. However, the study should be supervised by a radiologist and, when positive, a full MR study should be performed as it may change findings in 42% to 54% of cases.

Clinical Relevance/Application
Coronal STIR MR can be used as a screening for evaluation of acute non-traumatic hip pain in children. However, when positive, a full MR study should be performed as it can alter the findings in about half of the cases.
CLINICAL RELEVANCE/APPLICATION

Post intervention hip spica MRI is useful in determining need for reintervention after closed hip reduction but its role after open reduction is questionable.

RC213-12  **Isolated Posteromedial Subtalar Coalitions: Incidence and Associated Morphologic Alterations of the Sustentaculum Tali**

Monday, Nov. 30 11:10AM - 11:20AM Location: N230

**Participants**
Sarah D. Bickey, MD, Boston, MA (Presenter) Nothing to Disclose
Delma Y. Jarrett, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Patrick Johnston, MSc, Cambridge, MA (Abstract Co-Author) Employee, Ora, Inc
Susan Mahan, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Paul K. Kleinman, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To determine the prevalence and morphologic alterations of subtalar coalitions which lie entirely posterior to the middle facet (MF), AKA "posteromedial subtalar (PMST) coalition."

**METHOD AND MATERIALS**
After obtaining IRB approval, radiology records from 2004-2012 were reviewed to identify CT studies of patients with confirmed subtalar coalition. 97 subjects (48 male, 49 female, mean age 13.73 years) with subtalar coalition were identified. Electronic medical records were reviewed and symptoms of foot or ankle pain were confirmed in all subjects. In 41 (42%) subjects the coalition was bilateral. CT images of 138 subtalar coalitions were reviewed to determine site of coalition. In those patients with isolated PMST coalitions, multiplanar reformatted images along the long axis of the sustentaculum tali (ST) were generated, from which the antero-posterior dimensions of the ST and MF were measured. A posterior sustentaculum (PS) measurement was then calculated defining the posterior extension of the ST beyond the middle facet (PS = ST-MF). Ratios of the MF to the PS measurements were calculated. 33 patients undergoing CT for triplane ankle fracture (21 male, 12 female, mean age 13.70 years) served as controls. Measurement were performed independently by two readers, and intra- and inter-reader reliability was estimated via a component of variance model.

**RESULTS**
97 of the 138 coalitions (70.2%) affected the MF and 2 (1.4%) involved the posterior facet. There were 39 (28.2%) isolated PMST coalitions identified in 33 patients (18 male, 15 female, mean age 14.07 years). The mean AP measurement of the MF and PS in the patients with PMST coalition were 12.70 mm and 15.90 mm, respectively, compared to 16.50 mm and 6.36 mm in the control population (p<0.001). The ratio of the MF to PS was 0.80 for PMST coalition patients versus 2.6 for controls (p<0.001).

**CONCLUSION**
In our cohort, 1/4 of all subtalar coalitions were of the PMST variety associated with an intact, but significantly shorter MF, and longer ST. This observation may aid in accurate diagnosis and provide insights into the morphogenesis of this relatively common disorder

**CLINICAL RELEVANCE/APPLICATION**
The presence of a "normal" middle facet at imaging may lead to missed isolated PMST coalitions; the morphology of the ST and MF provide helpful imaging clues to the diagnosis.

RC213-13  **A Retrospective Study to Evaluate the Effect Recent Changes to NICE Guidelines Will Have on Imaging of the Paediatric Cervical Spine in Blunt Trauma in the UK**

Monday, Nov. 30 11:20AM - 11:30AM Location: N230

**Participants**
Joseph Davies, MBBS, MRCS, London, United Kingdom (Presenter) Nothing to Disclose
Sammy Anwuzia, BSc,MSc, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Jane Evanson, MD, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Susan Cross, MBChB, FRCR, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Paediatric cervical spine (c-spine) injury is a rare but devastating event. Imaging, particularly Computed Tomography (CT) is the investigation of choice to exclude injury. CT is however associated with increased thyroid radiation dose and risk of developing malignancy vs plain radiographs. Insufficient paediatric c-spine trauma data exists to produce robust imaging guidelines. There have been recent changes to NICE UK guidelines relating to evaluation of paediatric (<10 years) c-spine injury in trauma. We set out to investigate effects these changes have on the use of Computed Tomography (CT) in the investigation of c-spine injury

**METHOD AND MATERIALS**
5 year retrospective study of c-spine imaging in patients <10 years presenting to a level 1 trauma centre following blunt trauma. Data was collected relating to trauma mechanism, clinical presentation, radiologic evaluations and injury type. Patients with incomplete data were excluded. Criteria for c-spine CT in NICE head injury guideline 56 (CG 56) (GCS<8, inadequate plain radiographs, strong suspicion despite normal plain radiographs) and NICE head injury guideline 176 (CG176) (GCS <13, intubated, focal neurology, polytrauma, suspicion despite normal radiographs) were retrospectively applied to all cases with complete data to determine the proportion of patients requiring c-spine evaluation with CT.

**RESULTS**
278 patients underwent c-spine imaging and 217 had complete data. 80 patients met the criteria for a CT of the c-spine under CG 56, 4 of which had a significant c-spine injury. 1 patient with c-spine injury and a presenting GCS of 14 did not meet CG 56. 206 patients met the criteria for a CT under CG 176, 5 of which had a significant injury. Overall, there was one patient who presented
with significant c-spine injury who did not meet CG 56 guidelines, but falls under CG 176 criteria.

**CONCLUSION**

CG 176 is more inclusive and if followed will result in higher proportion of paediatric blunt trauma cases being eligible for a c-spine CT without an initial plain radiograph series. Increased paediatric thyroid radiation exposure will result.

**CLINICAL RELEVANCE/APPLICATION**

New guidelines are more sensitive for selecting c-spine injury, specificity is lower and results in potentially unnecessary thyroid irradiation. Further study is required to develop more robust paediatric trauma imaging guidelines.

**RC213-14 Three-Point Dixon Technique for Fat Quantification and for Identifying Wasting Progression Rate of Pelvic and Thigh Muscles in Duchenne Muscular Dystrophy**

**Participants**

Jing Du, MD, Beijing, China (Presenter) Nothing to Disclose

Jiangxi Xiao, Beijing, China (Abstract Co-Author) Nothing to Disclose

Xiaoying Wang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

Ying Zhu, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

Fei Y. Li, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Three-point Dixon technique was applied to quantify fat fraction (FF) and identify the annual rate of disease progression of leg muscles in Duchenne muscular dystrophy (DMD).

**METHOD AND MATERIALS**

This prospective study was approved by the Ethical Committee. Ninety boys with genetically and/or pathologically confirmed DMD were recruited. Imaging was performed with a 3-T unit by using a 32 channel phased-array coil. A quantitative water-fat separation method (IDEAL-Quant) was used. Imaging parameters were as follows: TR=6.3ms, TE=1ms, 6 echoes, bandwidth=111.11 kHz, FOV=32-40cm, slice thickness=7mm, matrix=160x160, flip angle=3°, covering from the iliac crest to the knee, total imaging time=1min3sec. Images were processed on ADW4.6 workstation and FF of each muscle was calculated. The region of interest (ROI) was manually placed by tracing the outline of the individual muscle on the section level of the muscle belly. 18 muscles on each side were analyzed. Spearman correlation test was used to evaluate the correlation between age and FF. Linear correlation was used to show the relationship between age and FF.

**RESULTS**

90 DMD boys aged 2-13 (mean 5.8 years) were enrolled. The gluteus maximus was the most severely infiltrated (mean FF 28.82±19.96%), followed by the adductor magnus (mean FF 23.13±22.47%). The least affected muscle was the obturator externus (mean FF 3.67±1.13%). Positive correlation was obtained between FF value and age for all the muscles with correlation coefficient varied from 0.28 to 0.76. Significant correlation was seen in the gluteus maximus muscle (r=0.68), adductor magnus (r=0.74), and the quadratus femoris (r=0.74~0.76). The muscle wasting progression can be calculated as (A + B*age). A stands for a constant and B stands for annual progression rate varied from 0.3% to 6.1% for different muscles.

**CONCLUSION**

IDEAL-Quant method can be used to quantitatively assess leg muscle fatty infiltration and identify muscle wasting progression in DMD patients.

**CLINICAL RELEVANCE/APPLICATION**

IDEAL-Quant method can be used to quantitatively assess leg muscle fat infiltration in DMD. This method should be used to monitor disease severity and follow-up.

**RC213-15 Sports Injuries of the Pediatric Knee**

**Participants**

Jennifer Stimec, MD, Toronto, ON (Presenter) Nothing to Disclose
**LEARNING OBJECTIVES**

1) Recognize and identify pitfalls of scanning that lead to false positive or false negative musculoskeletal ultrasound results. 2) Perform skills for scanning difficult patients. 3) Follow rigorous protocols for the examination of different anatomic regions. 4) Position patients for more complicated musculoskeletal ultrasound examinations. 5) Recognize and integrate the importance of tissue movement in judging the functionality of the extremities.

**ABSTRACT**

In this Musculoskeletal Ultrasound Master class, an opportunity will be given to participants to start a written dialogue in advance to RSNA 2012. The electronically submitted questions will be sorted by instructors and organized per topic. A select number of recurring themes in these questions will be prepared for dialogue on stage. When the questions focus on a particular scanning skill, the authors of the questions will be invited on the examination platform to show problems they encounter in their practice. By using a step-by-step approach in solving the scanning issues, all who are present should benefit from the technical interactions on stage. Cameras will project scanning details on large screens. The seating in the master class will guarantee close proximity for an enriching interaction between audience and stage. At the end of the master class, the audience will be broken up in smaller groups for a more personal interaction with the instructors with the intent of improving scanning skills on an individual level.
Musculoskeletal Monday Poster Discussions

Pre-Operative Radiographic Findings Predict Outcomes after Total Hip Replacement

Participants
Daniel B. Nissman, MD, MPH, Raleigh, NC (Moderator) Royalties, John Wiley & Sons, Inc

Sub-Events

Pre-Operative Radiographic Findings Predict Outcomes after Total Hip Replacement

Station #1

Participants
Zachary J. LoVerde, MD, Reading, PA (Presenter) Nothing to Disclose
Susan M. Goodman, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Lisa Mandl, MD, MPH, New York, NY (Abstract Co-Author) Nothing to Disclose
Douglas N. Mintz, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
John A. Carrino, MD, MPH, New York, NY (Abstract Co-Author) Consultant, BioClinica, Inc; Consultant, Pfizer Inc; Advisory Board, General Electric Company; Advisory Board, Halvard Health, Inc
Mark P. Figgie, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
David Mayman, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jayme C. Burket, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE

Total hip replacement (THR) is the definitive treatment for end-stage arthritis. However, 4-6% of THRs have poor pain and function outcomes. This study determines x-ray findings associated with 2-year outcomes in the operated and non-operated hip.

METHOD AND MATERIALS

Primary THR enriched for poor outcomes (WOMAC <60) undergoing THR for osteoarthritis and a convenience sample of THR with good outcomes (WOMAC >60) enrolled in an institution registry between 1/2008 and 12/2010 were selected. All had baseline and 2 year self-report data, pre-op pelvis x-rays, and no contralateral THR. Patients with a new TJR within 2 years, inflammatory arthritis or trauma were excluded. Pre-op radiographs were scored for both hips, including joint space narrowing score (sum of 5 regions of the femoral head, 0=no narrowing, 1=narrowing), presence of synovial herniation pits, subchondral cysts, osteophyte score (0-10), hip offset and migration, and modified Kellgren-Lawrence (mKandL) score. Univariate analysis and multivariate logistic regression were performed.

RESULTS

274 THR radiographs were reviewed: 40 (14.6%) with poor pain, 58 (21.2%), poor function and 208 (76%) with good WOMAC pain and function at 2 years. THR with poor pain were more likely to be female (p-value 0.02). Controlling for age, sex, pre-operative BMI, co-morbidities, and activity level, each additional region of narrowing on the operative side decreased the odds of poor pain: OR 0.51 (95% CI 0.35-0.73). On the non-operative side, the presence of synovial pits increased the odds poor pain: OR 3.2 (95% CI 1.24-8.09). On the operative side, each additional region of narrowing decreased the odds of poor function: OR 0.44 (95% CI 0.30-0.65). On the non-operative side, the odds of poor function are increased by the presence of femoral cysts: OR 3.17 (95% CI 1.03-9.81), superior joint space narrowing: OR 2.42 (95% CI 1.03-5.67), and decreased by the presence of femoral head flattening: OR <0.001 (95% CI <0.001-0.29). Pain outcomes predicted correctly in 78.7% with x-rays vs. 71.9% (c-statistic 0.79 vs 0.72). Function: 78.5% with x-rays vs. 63.3% (c-statistic 0.79 vs 0.64).

CONCLUSION

Radiograph findings can be used to predict odds of poor pain or function 2-years after THR. Severe operative side changes predict benefit, while non-operative side changes may prevent optimal improvement.

CLINICAL RELEVANCE/APPLICATION

This may allow surgeon to advise patients at high risk for poor outcomes.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

John A. Carrino, MD, MPH - 2013 Honored Educator
John A. Carrino, MD, MPH - 2015 Honored Educator

The Utility of Clinical Examination and MRI Semi-quantitative Scoring Methods for Assessing Knee Joint Effusions in Osteoarthritis, and Their Relationship to Clinical Status and Medium-term Outcomes.

Data from the Osteoarthritis Initiative

Station #2

Participants
Benjamin R. Smith, MBChB, Edmonton, AB (Presenter) Nothing to Disclose
Robert G. Lambert, MBChB, Edmonton, AB (Abstract Co-Author) Research Consultant, Abbott Laboratories
PURPOSE
1. To evaluate the sensitivity and specificity of clinical examination of knee joint effusions in patient’s with osteoarthritis (OA) as referenced to semi-quantitative MRI effusion scoring methods (MOAKS/KIMRISS).
2. To evaluate the significance of clinically or MRI detectable knee joint effusions at OA presentation with relation to clinical status, WOMAC score, cortisone injection rate and the incidence of total knee replacement within 5 years.

METHOD AND MATERIALS
This cohort study includes 80 patients selected from the OA Initiative database - 40 who had cortisone injections within 1 year of presentation and 40 matched patients who did not. The following data was extracted: 1. Result of the patella tap and bulge tests at presentation. 2. WOMAC score at presentation. 3. Incidence of cortisone injection within 1yr. 4. Incidence of total knee replacement (TKR) within 5 yrs. The baseline MRIs were analysed for the presence of joint effusions using two invidual semi-quantitative scoring methods - MOAKS score and KIMRISS score (developed at our institution). Two MSK radiologists read the scans independently.

RESULTS
A total of 63/80 (79%) of patients had MRI detectable effusions at presentation. 23% of patients had a positive bulge sign (specificity 0.75, sensitivity 0.6) , and just 5% of patients had a positive patella tap sign. Bulge-positive patients had significantly higher WOMAC pain (5.4 vs 3.7, p=0.03) and disability (27 vs 18 p=0.02) scores at presentation compared to bulge negative knees. 78% of bulge-positive knees progressed to cortisone injection within 1 year vs 58% bulge-negative (p=0.007). 98% MRI effusion-positive knees had cortisone injections within 1 year vs 42% MRI effusions-negative knees (p<0.001). 30% of MRI effusion-positive knees progressed to TKR by year 5, vs 0% of MRI effusion-negative knees. Having a positive-bulge sign was associated with a 2-3 x increased incidence of TKR at yr 5.

CONCLUSION
MRI and clinically detectable effusions in knee OA at presentation are strongly associated with worse WOMAC scores, increased incidence of cortisone injections at 1 year and progression to TKR by year 5. No MRI effusion-negative patients had TKR by year 5, compared to 30% of effusion-positive knees.

CLINICAL RELEVANCE/APPLICATION
Semi-quantitative MRI scoring methods for knee effusions (MOAKS and KIMRISS) provide a useful and sensitive tool in evaluating knee OA, and have strong correlation with clinical status and outcomes.

PURPOSE
To investigate the correlation of CT perfusion parameters of rabbits in acute gouty arthritis with its expression of transforming growth factor β-1(TGFβ-1) and asacular endothelial growth factor(VEGF).

METHOD AND MATERIALS
Thirty five New Zealand white rabbits were randomly divided into two groups: thirty rabbits in experimental group and five in control group. The control group had no treatment, but rabbits in the experimental group was injected with sodium urate solution and polymyxin in the right knees, creating acute gouty arthritis disease models. The experimental group was divided into six subgroups randomly with five rabbits in each one, and for every 4h, 16h, 32h, 48h, 60h, and 60h after injection, one experimental subgroup underwent CT perfusion. The control group was scanned for once at any time. Parameter values of blood volume (BV), blood flow (BF), and clearance rate (CL) in region of interest were measured in the right knees, within which the content of TGFβ-1 and VEGF was detected in the fluid.

RESULTS
Perfusion parameters and the content of TGF-β1, VEGF of the experimental group were compared with the control group (Independent-samples T test, P <0.01). BF, BV, and CL in experimental group were different at those six intervals(one-way ANOVA and LSD t test, P<0.05). With Spearman Rank Correlation Analysis, there is a positive correlation among perfusion parameters, VEGF and TGF-β1 in experimental group (BV vs VEGF, r=0.871, p<0.01; BV vs TGFβ-1, r= 0.77 , p<0.01; BF vs VEGF, r=0.946, p<0.01; BF vs TGFβ-1, r=0.699, p<0.01; CL vs VEGF ,r=0.908, p<0.01;CL vs TGFβ-1,r=0.798, p<0.01;VEGF vs TGFβ-1,r=0.593, p<0.01).

CONCLUSION
CT perfusion parameters and expression of TGFβ-1, VEGF have correlation in rabbit models with acute gouty arthritis, and perfusion parameters may assess pathogenesis of the models.

CLINICAL RELEVANCE/APPLICATION
CT perfusion imaging provides a new thought for exploring the pathogenesis of acute gouty arthritis, and may provides a new method for the early treatment.
Participants
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PURPOSE
To identify all three popliteomeniscal fascicles on 3D T1 weighted images of the meniscus.

METHOD AND MATERIALS
Patients with suspected meniscal tear but normal menisci on MR imaging were included. Radial reformats of routinely performed 3D T1 weighted sequence were evaluated retrospectively by two blinded readers. The following measurements and observations were obtained: visibility/non-visibility of the anteroinferior, posterosuperior and posteroinferior fascicle; the region where the fascicles are visualized in degrees compared to the tangential to posterior surface of the menisci. Intra-/Inter-reader agreement were tested.

RESULTS
37 patients with 40 MR examinations of the knee were included in the study. 115 of 120 fascicles could be identified. The anteroinferior fascicle was visible from 44°-40° (range:70°/-1.8°), the posterosuperior from 63°-55° (range 93°/-89.7°), and the posteroinferior from 56°-36° (range 89.6/-88.9°). Intra- and inter-reader agreement showed moderate to substantial agreement.

CONCLUSION
In this study all three popliteomeniscal fascicles could be consistently visualized on 3D T1 weighted images.

CLINICAL RELEVANCE/APPLICATION
Better understanding of the clinical significance of injuries to the posterolateral corner of the knee has led to an increasing focus on clinical evaluation and treatment of this region. The popliteomeniscal fascicles function as stabilizers of the lateral meniscus. In the literature there is usually described an anteroinferior fascicle and a posterosuperior fascicle. More recently in a cadaveric MR-arthrography study a third, the posteroinferior fascicle was described.

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Jon A. Jacobson, MD - 2012 Honored Educator

MK332-SD-MOAS
Prevent Partial and Full-thickness Focal Cartilage Defects Predict Cartilage Damage Progression in the Same Subregion and Development of Incident Cartilage Damage in the Same Tibiofemoral Compartment: The MOST Study

Station #5

Participants
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PURPOSE
To assess if depth of focal cartilage damage affects the risk of incidence and progression of cartilage loss in the tibiofemoral joint (TFJ).

METHOD AND MATERIALS
Persons with or at high risk of knee OA with MRI readings at baseline and 30-month were included. Semiquantitative MRI analysis was done using the Whole Organ MRI Score (WORMS) for cartilage damage, meniscal damage and extrusion, bone marrow lesions (BMLs), effusion and synovitis. Baseline focal cartilage damage was defined as grade 2 (partial-thickness) or grade 2.5 (full-thickness). In a subregion-based analysis, we assessed the risk of cartilage loss over 30 months comparing subregions of TFJ with baseline cartilage grade 2.5 vs grade 2. In the compartment-based analysis, we included only knees with a solitary grade 2 or 2.5 lesion at baseline and all other subregions in the same compartment having no cartilage damage. We estimated the risk of incident cartilage loss (grade≥2) in any non-damaged subregions for compartments with baseline full-thickness (BMLs). In a subregion-based analysis, we assessed the risk of cartilage damage progression for grade 2.5 lesions compared to grade 2 lesions were comparable. However, compared to subregions with no cartilage damage, subregions with grade 2 or 2.5 cartilage defects had higher risk for cartilage loss (aOR 8.2, 95%CI 6.7-10.0). 374 compartments were included in the compartment-based analysis. There was no significant difference in regard to risk of incident damage between compartments that had grade 2 and grade 2.5 cartilage defects at baseline. However, compared to compartments with no baseline cartilage...
damage, those with grade 2 or 2.5 cartilage defects in a subregion had higher risk for incident cartilage damage in other subregions at follow-up (aOR 1.7, 95%CI 1.2-2.5).

CONCLUSION
Prevalent focal cartilage defects are a risk factor for local cartilage damage progression in the same subregion and increase risk for development of incident cartilage damage in the same TFJ compartment regardless of defect depth.

CLINICAL RELEVANCE/APPLICATION
Even small superficial cartilage lesions are relevant for cartilage damage progression.

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Ali Guermazi, MD, PhD - 2012 Honored Educator

PURPOSE
Bipartite medial cuneiform (BMC) is an uncommon and underrecognized variant that has received little mention in radiology literature and texts. There is increasing evidence suggesting that BMC may be an etiology for midfoot pain. As with Lisfranc injuries, BMC can be easily overlooked amidst the complex anatomy of the midfoot. We have observed a beaked appearance of the navicular in patients with BMC. The purpose of this study is to evaluate the "beaked navicular sign" as an indirect radiographic finding of BMC.

METHOD AND MATERIALS
IRB approval was obtained. 11 cases of BMC were identified in adult patients from institutional teaching files. 36 age matched random controls were also identified. Lateral foot radiographs of these 47 subjects were retrospectively reviewed for the presence or absence of the "beaked navicular" sign by 4 readers. The medial cuneiform was masked in each image to prevent direct identification of BMC. Agresti-Coull confidence intervals were constructed for sensitivity and specificity of the "beaked navicular" sign for BMC.

RESULTS
Among the four readers, the sensitivity of the 'beaked navicular' sign ranged from 82% (0.51 - 0.96, 95% CI) to 91% (0.60 - 1.00, 95% CI), specificity from 86% (0.71 - 0.94, 95% CI) to 97% (0.85 - 1.00, 95% CI). Positive predictive value ranged from 64% (0.39 - 0.84, 95% CI) to 91% (0.60 - 1.00, 95% CI) and negative predictive value from 94% (0.79 - 1.0, 95% CI ) to 97%(0.84 - 1.000, 95% CI).

CONCLUSION
Our study confirms the 'beaked navicular" sign as a sensitive and specific indirect radiographic sign of BMC, with high negative predictive value.

CLINICAL RELEVANCE/APPLICATION
Recognition of the beaked navicular sign should prompt careful evaluation for the potentially symptomatic BMC.

PURPOSE
To determine whether known variant anatomical relationships between the sciatic nerve and piriformis muscle can be readily identified on routine MRI studies of the hip and to calculate the prevalence of the most common variants.

METHOD AND MATERIALS
Hip MRI studies containing axial T1 sequences acquired over a period of four years at two university medical centers underwent repeat interpretation by musculoskeletal radiologists. The anatomical relationship between the sciatic nerve and the piriformis muscle was analyzed and categorized according to the Beaton and Anson classification system. The presence of a split sciatic nerve, defined as separate common peroneal and tibial nerve bundles at the level of the ischial tuberosity, was also recorded.

RESULTS
At one institution, a total of 125 consecutive scans were reviewed after the exclusion of 9 cases for severe metal artifact from prior hip arthroplasty. Conventional anatomy (Type I) in which an undivided sciatic nerve passes below the piriformis muscle was
identified in 88% of cases. The remaining 12% of cases demonstrated a Type II pattern in which one division of the sciatic nerve passes through the piriformis while the second passes below. Another 102 consecutive scans were reviewed at a second institution after exclusion of 29 cases. In that series, 20% of cases demonstrated a Type II pattern. A single Type III variant was also identified in which one division of the sciatic nerves above the piriformis while the other courses below. The remaining three types of variants described in the Beaton and Anson classification system were not identified. Over 95% of variant cases were associated with a split sciatic nerve. By contrast, only 4% of cases at the first institution and 14% at the second demonstrated a split sciatic nerve in the context of otherwise conventional anatomy.

CONCLUSION

Anatomic variations of the sciatic nerve course in relation to the piriformis muscle can be identified on MRI and are fairly common, occurring in 12-20% of scans reviewed. Almost all of the variants identified were Type II. MRI allows for accurate determination of variant anatomy, facilitating optimal treatment planning.

CLINICAL RELEVANCE/APPLICATION

Variant relationships between the sciatic nerve and piriformis muscle are associated with piriformis syndrome and identification of these variants on MRI is important in diagnosis and treatment planning.

MK114-ED- MOAB

Four Corners of the Knee: Anatomy, Biomechanics, Imaging and Therapeutic Management of Injuries of the Capsular Ligament Complexes and Knee Instability

Station #8

Participants

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TEACHING POINTS

To describe in detail the anatomy and MRI appearance of the four capsule-ligament complexes of the knee (CLC) with cadaveric-arthroscopic correlation. To review biomechanics, clinical assessment and injury patterns of CLC insufficiency. To provide an understanding classification of the knee instability. To evaluate the utility of MRI in patients with CLC injuries and knee instability. To describe in detail the management of pathologic conditions of CLC.

TABLE OF CONTENTS/OUTLINE


MK156-ED- MOAS

Echographic Evaluation of the Brachial Plexus: How to Do It

Station #9

Participants

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TEACHING POINTS

The goal of this exhibit is to: (1) Review the anatomy of the brachial plexus. (2) Recognize the anatomical landmarks by ultrasound. (3) Explain a step-by-step guide for the echographic exploration of the brachial plexus. (4) Demonstrate the value of ultrasonography in specific pathologies of the brachial plexus.

TABLE OF CONTENTS/OUTLINE

A- Objectives. B- Graphic illustrations showing the brachial plexus anatomy, correlation with ultrasound studies and cadaveric specimens. C- Ultrasound instrumentation and preparation of the patient. D- Normal echographic appearance of the brachial plexus and ultrasound technique using anatomic landmarks. E- Limitations and pitfalls of the ultrasound for the evaluation of the brachial plexus. F- Assessment of frequent pathological conditions involving the brachial plexus. G- Take Home Points.

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Jeffrey J. Peterson, MD - 2012 Honored Educator

MK203-ED- MOA10

High-resolution Imaging of Metabolic Bone Diseases

Station #10
TEACHING POINTS

Metabolic bone diseases are of high prevalence and major clinical relevance: Patients affected display a major risk of fragility fractures. Besides densitometric techniques that are used in clinical practise (e.g. DXA or QCT), high-resolution bone imaging has evolved as an important non-invasive tool in bone research. In the proposed educational exhibit, we aim to demonstrate high-resolution characteristics of metabolic bone diseases with a special focus on high resolution peripheral quantitative computed tomography (HR-pQCT): Examples of female and male healthy volunteers will be shown along with cases of primary and secondary osteoporosis, disuse, chronic kidney disease, diabetes mellitus and hypo- and hyperparathyroidism. Special emphasis will be put on teaching disease-specific differences of pathologic bone microarchitecture (e.g. cortical porosity in diabetic bone disease; subperiosteal resorptions in hyperparathyroidism) based on non-invasive imaging.

TABLE OF CONTENTS/OUTLINE

High-resolution imaging of metabolic bone diseases: Technical background (HR-pQCT; HR-MRI); Cases: healthy men/women; postmenopausal and age-related osteoporosis; secondary osteoporosis; chronic kidney disease bone and mineral disorder; disuse; diabetes mellitus; hyper- and hypoparathyroidism; pediatrics: x-linked hypophosphatemic rickets, spinal muscle atrophy (SMA)

Adult Spinal Deformity: Pertinent Radiographic Findings for the Surgeon

The purpose of this exhibit is to: 1. Explain the Scoliosis Research Society classification of adult spinal deformity. 2. Analyze important spinopelvic parameters, including sagittal measurements and global balance modifiers. 3. Discuss how these findings effect management considerations.

TABLE OF CONTENTS/OUTLINE

Use and image and diagram rich platform to discuss the following and provide a systematic algorithmic approach for analyzing and reporting these findings: Scoliosis Research Society (SRS) classification of adult spinal deformity. Most important parameters for surgical planning in the adult, including segmental (subluxation), regional (lumbar lordosis) or global sagittal imbalance. Regional spinal Cobb measurements of thoracic kyphosis and lumbar lordosis, as will spinopelvic parameters, such as pelvic tilt, pelvic inclination, sagittal vertical axis, and T1 pelvic angle. Concepts behind pelvic compensation mechanisms and imbalanced sagittal profiles. Discuss the surgical implications of the above findings.
Participants

**Role of MRI in the Evaluation of Response to Treatment with HUMIRA (Adalimumab) in Patients with Non-radiographic Axial Spondyloarthritis (SpA): A Preliminary Study**

Station #1

**Participants**

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**PURPOSE**

Involvement of sacroiliac joint is usually the first manifestation of seronegative spondyloarthopathy; this condition can be detected with high accuracy by MRI sequences, according to the axial spondyloarthritis classification criteria published by the Assessment of SpondyloArthritis international Society (ASAS). The aim of our study was the evaluation of response to treatment with HUMIRA (Adalimumab), a recombinant human IgG1 monoclonal antibody specific for human TNFα, through MRI.

**METHOD AND MATERIALS**

In collaboration with the Department of Rheumatology, we followed a group of 20 patients with clinical and laboratoristic diagnosis of SpA, performing three sessions of MRI: the first before starting treatment (t0), 6 months later (t1) and 1 year after treatment (t2), in the period between December 2013 and February 2015. The examinations were performed with a 1.5 T Siemens Sonata MRI scanner, with standardized acquisitions: axial, coronal and oblique sequences, according to the plane of synchondrosis joint, TSE T1 and T2 TIRM; post-contrastographic T1 FAT SAT.

**RESULTS**

Of the 20 patients at t0 everyone had a clinical confirmation of low back pain and a positive bone marrow edema, signal-presence of bone marrow hyperintensity on FAT SAT T1-weighted images and enthesitis, 2 had bony bridges (10%), 13 shown subchondral sclerosis and fatty change (65%) and 12 of them presented microerosions (60%). At t1, 2 of the 20 patients have discontinued therapy because of side effects; of the remaining 18, 6 patients showed an improvement in clinical regression of pain, while none of these showed a concomitant improvement in the images acquired. At t2, 16 of the 18 patients showed an important clinical reduction of low back pain with periods of exacerbation, 2 were not responding to treatment. The acquired images showed a reduction of contrast enhancement and enthesitis in all cases, while only 6 showed a reduction of bone marrow edema (30%) and no changes as regards the sclerosis, the microerosions, fatty change and subchondral bony bridges.

**CONCLUSION**

This study showed that MRI is now recognized to play a pivotal role in the diagnosis of early sacroiliitis and for evaluation of response to treatment, in particular the actual effectiveness of treatment with HUMIRA in terms of disease progression and quality of life.

**CLINICAL RELEVANCE/APPLICATION**

MRI is an important tool in the evaluation of treatment response of early sacroiliitis.

**Bone Marrow Diffusion-Weighted MRI of Multiple Myeloma Patterns**

Station #2

**Participants**

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**PURPOSE**

To calculate and compare ADC values in newly diagnosed patients with multiple myeloma (MM), to identify possible differences in ADC values among diffuse, focal, and normal MM MRI patterns and to establish the presence of a threshold value which may distinguish abnormal from normal patterns.
METHOD AND MATERIALS

95 patients with newly diagnosed untreated MM were studied with MRI of the lumbosacral spine, with a 1.5 Tesla unit. There were 46 men and 49 women with a mean age 67 years (range 37-89). 16 healthy individuals served as a control group (7 men, 9 women, mean age 59.2 years, range 47-76). Conventional MR images were obtained according to bone marrow MRI protocols; MRI patterns of involvement were normal in 51, focal in 20, diffuse in 24 patients. DWI was obtained with an Echo Planar Imaging sequence using 5 b-values (0, 150, 250, 500, 750 sec/mm2).

RESULTS

Mean ADC values (x 10-3 mm2/sec) were: 0.360 ± 0.108 (range: 0.153 - 0.593) for the normal MM pattern, 1.101 ± 0.308 (range: 0.715 ± 2.015) for the focal MM pattern, 0.783 ± 0.132 (range: 0.552 ± 1.017) for the diffuse MM pattern. Mean ADC value of apparently normal marrow in patients with a focal pattern was 0.431 ± 0.128 (range: 0.113-0.704). Mean ADC of healthy controls was 0.360 ± 0.135 (range: 0.152 - 0.542). One way analysis of variance (ANOVA) showed a significant difference in ADC values within the groups of the study. An ADC value above 0.548x10-3 mm2/sec was found to be diagnostic of diffuse myelomatous infiltration of the bone marrow with 100% sensitivity and 98% specificity.

CONCLUSION

Normal, focal and diffuse MRI patterns of involvement in patients with MM have distinct ranges of ADC values on DWI. An ADC value above 0.548x10-3 mm2/sec is diagnostic of diffuse myelomatous infiltration of the bone marrow with very high accuracy.

CLINICAL RELEVANCE/APPLICATION

Diffuse MRI pattern of marrow involvement correlates with poor prognosis in patients with multiple myeloma (MM) both in the conventional chemotherapy and novel agent era and this exam is recommended in differentiating diffuse from normal MRI pattern involvement.

MK337-SD-MOB3
Radiographic Interpretation of Carpometacarpal Arthroplasty: Correlation between Radiographic Loosening and Clinical Outcome

Station #3

Participants
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PURPOSE

To assess the radiographic appearance and interpretation of loosening in patients following first carpometacarpal joint pyrohemisphere arthroplasty.

METHOD AND MATERIALS

A retrospective review over a six-year period was performed identifying patients with first carpometacarpal pyrohemisphere implants. All post-operative radiographs were reviewed and compared with clinical information. Loosening was defined as greater than 1 mm of periprosthetic lucency or increasing lucency on serial studies. Adverse clinical outcome was defined as infection, complex regional pain syndrome, subluxation or inability to return to activities of daily living. Statistical analysis included Cohen's Kappa coefficient to measure inter-reader agreement for radiographic interpretation as well as the agreement between radiographic loosening and an undesired or adverse clinical outcome.

RESULTS

A total of 73 post-operative radiographs were reviewed. The mean age of the study subjects was 58 years. The mean radiographic follow up was 13 months (range: 1-56). All arthroplasties were performed for osteoarthritis. Only 1 repeat surgery was performed. There was good agreement amongst readers in regards to radiographic interpretation, $K = 0.66$ ($p = 1.54 \times 10^{-8}$, 95% CI [0.48, 0.83]). The strength of agreement between radiographic loosening and adverse clinical outcome was poor, $K = 0.23$ ($p = 0.04$, 95% CI [0.02, 0.45]). The sensitivity of radiography in predicting an adverse clinical outcome was 63%, specificity 65%, positive predictive value 39% and negative predictive value 83%.

CONCLUSION

There is good agreement amongst readers in the assessment for loosening of pyrohemisphere implants. Poor agreement is seen between radiographic loosening and an adverse clinical outcome. Moreover, the sensitivity and specificity of radiography to predict adverse clinical outcomes are low. Although radiography may be useful in the right clinical context, it should not be utilized as the sole predictor of adverse clinical outcomes following carpometacarpal arthroplasty.

CLINICAL RELEVANCE/APPLICATION

Poor agreement is seen with radiography and adverse clinical outcome post carpometacarpal arthroplasty; while it may be useful in the right clinical context, it should not be the sole predictor.

MK338-SD-MOB4
Incidence and Patterns of Anteromedial Corner Injury of the Knee in Patients with Acute Anterior Cruciate Ligament Injury

Station #4

Participants
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PURPOSE
We aimed to determine incidence and patterns of the anteromedial corner injury of the knee on MRI of the patients with acute anterior cruciate ligament (ACL) injury, and to find MR findings associated with injuries of the medial patellofemoral ligament (MPFL) and medial patellar retinaculum (MPR) of the patients.

**METHOD AND MATERIALS**

We retrospectively reviewed preoperative knee MR images of 122 consecutive patients with ACL injury who had taken MRI in an average of 7 days after trauma and had underwent arthoscopic ACL reconstruction. 42 patients were excluded due to suboptimal image sequences, prior knee fracture or chronicity of ACL tear. This left 80 knees for this study (male: female = 64:16, mean age, 29.6 years). All MR images were independently assessed by two musculoskeletal radiologists for MPFL and MPR injuries. In addition, MR images were also evaluated for PCL, MCL, LCL, menisci, vastus medius obliquus (VMO), and bone contusion distribution.

**RESULTS**

In the 80 knees with acute ACL injuries, MPFL injuries were found in 66.3% (53 knees; periligamentous edema 32.5%, partial tear 26.3%, and complete tear 7.5%). MPR abnormalities were found in 51.3% (41 knees; periligamentous edema 27.5%, partial tear 18.8%, complete tear 5.0%). MPFL and MPR injuries were significantly associated with MCL injury (p < 0.0001), VMO strain (p < 0.0001), and bone contusion of lateral femoral condyle (p = 0.0001 and 0.022, respectively), but not with meniscal tears, PCL or LCL injuries.

**CONCLUSION**

Anteromedial corner injuries, i.e., MPFL and MPR injuries, were frequently observed on knee MRI of the patients with acute ACL injury.

**CLINICAL RELEVANCE/APPLICATION**

We believe that it would be worth researchers starting to consider potentially coexisting anteromedial corner injuries, i.e., MPFL and MPR injuries in a patient with ACL injury as a possible predictor variable for poorer outcome or early patellofemoral osteoarthritis after ACL reconstruction.

**MK339-SD-MOBS**

**Multiparametric Quantitative MRI Shows No Difference in Cartilage Composition between Patients with Patellofemoral Pain and Healthy Control Subjects**

**Participants**

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**PURPOSE**

Diminished cartilage quality is hypothesized as an etiological factor for patellofemoral pain (PFP), a common knee pathology in young subjects with unknown etiology. Our purpose was to investigate differences in cartilage quality between patients with PFP and control subjects by measuring cartilage composition with three different quantitative MRI techniques.

**METHOD AND MATERIALS**

Patients diagnosed with PFP and healthy control subjects aged 14-40 years were included and underwent MRI at 3T. The MRI protocol included high-resolution SPGR, T1GD (delayed gadolinium enhanced MRI of cartilage (dGEMRIC)), T1p and T2 mapping sequences to measure cartilage glycosaminoglycan (T1GD and T1p) and collagen content (T2). T1GD was only conducted in adults due to the need of contrast administration. An experienced observer manually annotated the whole trochlear and patellar cartilage on approximately 20 slices of the high-resolution scan. Automated image registration was applied to compensate for subject motion. Due to the need of contrast administration. An experienced observer manually annotated the whole trochlear and patellar cartilage on approximately 20 slices of the high-resolution scan. Automated image registration was applied to compensate for subject motion.

**RESULTS**

Differences in relaxation times for trochlear and patellar cartilage were compared between patients and controls by linear regression analyses, adjusted for age, BMI, gender, sports participation and time of day during visit.

64 patients and 70 control subjects were included of which 40, equally distributed between groups, were adolescents. Mean age was 23.2 (6.4), mean BMI was 22.9 (3.4) and 56.7% was female. Mean T1GD relaxation times of patellar (657.8 vs. 669.5 milliseconds (ms)) and trochlear cartilage (661.7 vs. 660.4ms) did not significantly differ between patients and controls (Table 1). There was also no significant difference in mean T1p relaxation times of patellar (46.6 vs. 45.8ms) and trochlear cartilage (50.8 vs. 50.1ms) and mean T2 relaxation times of patellar (33.2 vs. 32.8ms) and trochlear cartilage (36.7 vs. 36.6ms) between patients and controls. Analysis of pre-specified medial and lateral subregions within the patellar and trochlear cartilage did also not reveal any significant differences.

**CONCLUSION**

Our findings suggest that cartilage composition as measured with quantitative MRI does not play a role in the etiology of PFP.

**CLINICAL RELEVANCE/APPLICATION**

Diminished cartilage quality has been hypothesized as an etiological factor for PFP for many years, but our findings suggest that cartilage composition does not play a role in the etiology of PFP.
2D Fast Spin-echo Sequences at 3T

Station #6

Participants
Jisook Yi, MD, Bucheon-Si, Korea, Republic Of (Presenter) Nothing to Disclose
Jang Guw Cha, MD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Koo Lee, Bucheon-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Bora Lee, Bucheon-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine the accuracy of a three-dimensional (3D) isotropic T2-weighted fast spin-echo (FSE) magnetic resonance (MR) sequence as compared with a conventional two-dimensional (2D) sequence in the diagnosis of anterior talofibular ligament (ATFL) tear, osteochondral lesion of talus (OLT), and Os subfibulare/avulsion fracture of distal fibula (OSF).

METHOD AND MATERIALS
Between November 2013 and July 2014, thirty-five patients who had undergone ankle MRI with the 2D T2-weighted FSE sequence and the 3D isotropic T2-weighted FSE sequence and subsequent ankle arthroscopy were included. Each MR imaging sequence was independently scored by two readers retrospectively for the presence of complete or partial tear of ATFL, OLT and OSF. Diagnostic performance based on each sequence type was compared by using the area under the receiver operating characteristic curve (AUC). Interobserver agreement was expressed as unweighted kappa value.

RESULTS
Arthroscopic findings enabled confirmation of the presence of 21 complete tear of ATFL, 14 partial tear of ATFL, 17 OLT, and 7 OSF. The AUCs for the readers using the 3D T2-weighted FSE sequence versus those obtained with the 2D sequence were 0.71-0.96 versus 0.72-0.97 for reader A and 0.52-0.81 versus 0.65-0.92 for reader B in the detection of ATFL tears, 0.68 versus 0.83 for reader A and 0.74 versus 0.80 for reader B in the detection of OLTs and 0.83 versus 0.85 for reader A and 1 versus 0.89 for reader B in the detection of OLTs. The mean AUCs between the 2D and 3D sequences were not significantly different. The interobserver agreement rate between two readers using the 3D T2-weighted FSE sequence versus those obtained with the 2D sequence were fair versus moderate for ATFL tear, substantial versus moderate for OLT, and substantial versus substantial for OSF.

CONCLUSION
The accuracy of 3D isotropic FSE MRI may be comparable with that of conventional 2D MRI in the diagnosis of ATFL tears, OLT and OSF with a shorter imaging time.

CLINICAL RELEVANCE/APPLICATION
Three-dimensional isotropic T2-weighted FSE MRI of the ankle shows similar accuracy as more conventional imaging in the evaluation of ATFL tears, OLT and OSF of the ankle, with a faster imaging time.

Sciatic Neuromuscular Variants on MR Neurography: Prevalence Study and Interobserver Performance

Station #7

Participants
Jason P. Eastlack, MD, Dallas, TX (Presenter) Nothing to Disclose
Lulu Tenorio, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Kelly Scott, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Adam Starr, MD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
Avneesh Chhabra, MD, Dallas, TX (Abstract Co-Author) Research Consultant, Siemens AG; Consultant, ICON plc

PURPOSE
To evaluate the prevalence of sciatic neuromuscular variants on MR neurography and determine the interobserver variability in the recognition of these findings.

METHOD AND MATERIALS
Following institutional review board approval, retrospective evaluation was performed of a consecutive series of 137 lumbosacral plexus MR neurography exams. All exams were performed using nerve selective 3D imaging and independently reviewed by two separate readers. Three of the exams were excluded due to presence of metallic hardware. The remainder of the exams were reviewed for the presence of split sciatic nerves and piriformis muscle asymmetry. Interobserver performance was evaluated using kappa statistics.

RESULTS
The study included 101 women and 36 men. The average age was 50 years with a standard deviation of 16 years. There were a total of 44 limbs with split sciatic nerves (prevalence of 32.8%). The split sciatic nerves were bilateral in 12 patients (prevalence of 8.9%). The interobserver performance in the identification of split sciatic nerves was good to excellent with kappa values ranging from 0.55 to 0.9. There were a total of 7 limbs with piriformis muscle atrophy (prevalence of 5.2%) and 38 limbs with piriformis muscle hypertrophy (prevalence of 28.4%). The interobserver performance in the identification of piriformis muscle asymmetry was moderate to good with kappa values ranging from 0.39 to 0.61.

CONCLUSION
Split sciatic nerves and piriformis muscle asymmetry are commonly identified on MR neurography with moderate to excellent interobserver performance.

CLINICAL RELEVANCE/APPLICATION
Sciatic neuromuscular variants are common and well evaluated with MR neurography.
TEACHING POINTS

The first metatarsophalangeal (MTP) joint is flexible and strong, with complex capsuloligamentous anatomy. Injury to this joint can involve ligaments, capsular components, and osseous structures. 1. Review the complex capsuloligamentous anatomy of the 1st MTP joint and the supporting soft tissue structures of the plantar plate.2. Review mechanism of injury, clinical presentation, incidence, risk factors, and treatment for turf toe.3. Review the optimal imaging modalities and common radiographic findings for 1st MTP joint pathologies. Modalities will include X-ray, US, and MRI.4. Review other pathologies of the 1st MTP joint that can mimic turf toe.

TABLE OF CONTENTS/OUTLINE

1. Review of the complex anatomy of the 1st MTP joint and plantar plate with illustration, as well as normal US and MR imaging.2. Summary of turf toe injury including mechanism, presentation, risk factors, and treatment.3. Imaging review of pertinent findings in turf toe on CR, US and MRI.4. Review additional pathology of the 1st MTP joint with imaging findings to include osseous (fractures, sesamoiditis, avascular necrosis), soft tissue (tendonitis, tenosynovitis), hyperdorsiflexion injury, and arthritides.

MK118-ED-MOB8 Turf Toe and Other Injuries of the Hallux Plantar Plate - An Illustrative Review

Participants
Stephanie N. Histed, MD, Los Angeles, CA (Presenter) Nothing to Disclose
Daria Motarredi, MD, Washington DC, DC (Abstract Co-Author) Nothing to Disclose
Kira Chow, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Sulabha Masih, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Shahla Modaresi, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose

MK156-ED-MOB9 Normal and Injured Ankle Ligaments on Ultrasonography with Magnetic Resonance Imaging Correlation

Participants
Qian Dong, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, BioClinica, Inc; Royalties, Reed Elsevier; ;
David P. Fessell, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Sung Moon Kim, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Catherine J. Brandon, MD, Ann Arbor, MI (Abstract Co-Author) Stock options, VuCOMP, Inc
Corrie M. Yablon, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose
Gandikota Grish, MBBS, FRCR, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

By completion of this educational exhibit, the learner will be able to: Understand ultrasonography (US) examination technique and potential scanning pitfalls of ankle ligaments. Recognize US appearance of normal and injured ankle ligaments with magnetic resonance imaging (MRI) correlation.

TABLE OF CONTENTS/OUTLINE

Ankle ligaments US examination technique and scanning pitfalls are reviewed. Illustrating US appearance of normal and injured ankle ligaments with MRI correlation including lateral complex, medial complex and deltoid ligaments, syndesmosis, and spring calcaneonavicular ligament complex.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jon A. Jacobson, MD - 2012 Honored Educator

MK204-ED-MOB10 Spectrum of MR Imaging Findings in Musculoskeletal Tuberculosis: A Pictorial Review

Participants
Tejas Gosalia, MBBS, MD, Mumbai, India (Presenter) Nothing to Disclose
Foram B. Gala, MBBS, MD, Mumbai, India (Abstract Co-Author) Nothing to Disclose
Bharat M. Gala, MBBS, Mumbai, India (Abstract Co-Author) Nothing to Disclose
Bipin R. Shah, MBBS, MD, Mumbai, India (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1)To determine the imaging morphology of musculoskeletal tuberculosis.2)To identify the various sites of tuberculosis involving the musculoskeletal system.3)Usefulness of MRI in distinguishing tuberculous pathology from others.4)To determine the treatment outcome on follow up MRI.

TABLE OF CONTENTS/OUTLINE

Tuberculosis is one of the major health problem in developing countries. Extra pulmonary Tuberculosis is on the rise especially with increase in incidence of AIDS. Musculoskeletal Tuberculosis comprises a bulk of extra-pulmonary tuberculosis. The various sites involved are spine (most common), sacro-iliac, hip, knee, ankle, wrist and elbow joints. Although it can affect almost any joint. The spectrum of spinal tuberculosis consists of Intradiscal soft tissue, osteitis, posterior sub ligamentous collections, pre and bilateral paravertebral collections, bilateral psosas abscesses, involvement of costo-vertebral joints, compression on cord and nerve roots. In
the joints the primary imaging finding is synovitis which later causes erosions of the articular margins of the bones involved. In chronic stages the disease can present as extensive erosions, loose body formation, deformity and loss of joint function. A tuberculous sinus tract can be demonstrated extending from the intramedullary region up to the adjacent soft tissues and skin.

**TEACHING POINTS**

1. Optimize the MRI protocol in the assessment of joints, including classic morphological and new functional sequences such as Dixon sequence, DWI, DCE-MRI and T2 mapping and dGEMRIC for cartilage evaluation. 2. Analyse the utility of these techniques for articular evaluation, including large and small joints, in several clinical scenarios.

**TABLE OF CONTENTS/OUTLINE**

PURPOSE
To test the ability of secondary CT findings in patients with T- and L- spine fractures to predict disruption of the posterior ligament complex, a crucial determinant of fracture instability.

METHOD AND MATERIALS
105 consecutive ER patients with thoracic or lumbar spine fracture (fx) who had both CT and MRI from 2008-2012 were included. A composite gold standard was based on disruption of any PLC component by MRI or intraoperative exam findings. 3 blinded readers (2 neuroradiology trained emergency radiologists and 1 spine surgeon) graded CT scans for: VBT vertebral body translation/rotation, FJD facet joint subluxation/dislocation, FJW facet joint widening, FPL facet/pedicle/lamina fx, SPF spinous process fx, ISW interspinous distance widening, PEF posterior endplate corner fx. Analysis included interobserver agreement, and univariate and multivariate logistic regressions (performed separately by reader) to test associations between CT findings and gold standard PLC disruption (PLCD).

RESULTS
53 of the 105 patients had PLC disruption by gold standard. Interobserver agreement (averaged across reader pairs) was good for all CT findings, ranging from 92% for VBT to 72% for ISW. In univariate analysis, the strongest predictors of PLCD were FPL (OR 3.9-5.2, p<0.001 for all readers) and ISW (OR 1.8-3.1, all p<0.05). SPF and VBT showed significant results for 2/3 readers. PEF was not associated with PLCD. The overall presence of at least one of the CT findings had 70% average interobserver agreement, and OR 5.4-8.1 (all p<0.002) for PLCD, with sensitivity 75-90%, specificity 37-63%. Multivariate regression analysis showed similar results, with FPL as the most predictive individual CT finding, with sensitivity 30-57%, specificity 75-92%.

CONCLUSION
Several secondary CT findings can substantially increase suspicion for PLC disruption, with any abnormal CT finding increasing the odds of disruption by 5.4 or greater across all readers.

CLINICAL RELEVANCE/APPLICATION
Close attention to secondary CT findings in patients with T- or L- spine fractures may help radiologists predict PLC disruption and expedite appropriate management.

Sub-Events
SSE06-01 CT for Thoracic and Lumbar (T- and L-) Spine Fractures: Can CT Findings Accurately Predict Posterior Ligament Complex (PLC) Disruption?

Participants
Bharti Khurana, MD, Boston, MA (Presenter) Nothing to Disclose
Luciano M. Prevedello, MD, MPH, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Heidi Miracle, Boston, MA (Abstract Co-Author) Nothing to Disclose
Erwin Lin, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Steven T. McCormack, MD, Weston, MA (Abstract Co-Author) Nothing to Disclose
Christopher M. Bono, MD, Boston, MA (Abstract Co-Author) Advisory Panel, UnitedHealth Group; Royalties, Wolters Kluwer nv;
Mitchell A. Harris, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Aaron D. Sodickson, MD, PhD, Wayland, MA (Abstract Co-Author) Research Grant, Siemens AG; Consultant, Bracco Group

Honored Educators
Bharti Khurana, MD - 2014 Honored Educator
Aaron D. Sodickson, MD, PhD - 2014 Honored Educator
In this study, the diagnostic quality of RED-MDCT and RED-CBCT for wrist fractures proved to be similar and in some parts even

**CONCLUSION**

although this was significant only for one of the three raters. Interrater correlation was 0.93, 0.87 and 0.94 for radiography, RED-

The area under the ROC curve for fracture detection was higher for RED-MDCT and RED-CBCT compared to radiography, these differences were not significant. No significant differences were only between RED-MDCT and radiography (P=0.01). Although sensitivity for joint involvement and fracture displacement was higher

Pooled sensitivity for fractures was 87% for RED-MDCT, 78% for RED-CBCT and 58% for radiography, being significantly different only between RED-MDCT and radiography (P=0.01). Although sensitivity for joint involvement and fracture displacement was higher in RED-MDCT and RED-CBCT compared to radiography, these differences were not significant. No significant differences were detected concerning the modalities' specificities. Raters' certainty was higher in RED-MDCT and RED-CBCT compared to radiography, although this was significant only for one of the three raters. Interrater correlation was 0.93, 0.87 and 0.94 for radiography, RED-MDCT and RED-CBCT, respectively.

**CONCLUSION**

In this study, the diagnostic quality of RED-MDCT and RED-CBCT for wrist fractures proved to be similar and in some parts even
higher compared to radiography.

**CLINICAL RELEVANCE/APPLICATION**

RED-MDCT and RED-CBCT scans have a sufficient potential to improve the diagnostic quality for wrist fractures without raising radiation dose and should be tested in a clinical setting.

**SSE06-04  Diagnosis of Acute Fractures of the Thoracic Spine Using Bone Marrow Edema Detected by Dual-Energy CT**

Monday, Nov. 30 3:30PM - 3:40PM Location: N227

Participants

Dennis Parhar, BSc, Vancouver, BC (Presenter) Nothing to Disclose

Teresa I. Liang, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose

Ismail T. Ali, MBChB, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose

Patrick D. McLaughlin, FFRRCSI, Cork, Ireland (Abstract Co-Author) Speaker, Siemens AG

Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The assessment of bone marrow edema is limited in conventional CT. Dual-energy CT (DECT) with virtual non-calcium (VNCa) images allows subtraction of bone mineral to better reveal the fluid attenuation of bone marrow. The purpose of this study is to describe our clinical experience with DECT VNCa images for the detection of bone marrow edema in acute fractures of the thoracic spine.

**METHOD AND MATERIALS**

In this retrospective study, 397 thoracic vertebral bodies from 36 consecutive patients were assessed for the presence of bone marrow edema in acute fractures. Each of these patients underwent DECT of the thoracic spine (100kV-Sn140kV, 255mAs, 40x0.6mm) using a dual source 128-slice CT scanner (Definition FLASH, Siemens Healthcare, Germany) between November 9, 2014 and March 31, 2015. The DECT data was post-processed using a 3-tissue algorithm to create VNCa images on a multimodality CT workspace. Each vertebral body was independently evaluated by two readers for the presence or absence of abnormal bone marrow edema on greyscale and color-coded maps. Attenuation of each of the vertebral bodies was then obtained. This data was then subjected to receiver operating characteristic (ROC) curve analysis to determine the sensitivity, specificity, and accuracy of using bone marrow edema to diagnose acute fractures of the thoracic spine.

**RESULTS**

Vertebrae positive for acute fracture demonstrated a statistically significant increase in the attenuation of abnormal bone marrow edema (114.2 ±15.06HU in acute fractures compared to -2.118 ±1.699HU in non-fractures, p<0.0001). Inter-observer agreement for the presence of abnormal bone marrow edema was excellent (k=0.865). The ROC analysis of the CT attenuation values demonstrated an area under curve (AUC) of 0.987 with an optimal cutoff value of 43.5 HU. This resulted in a sensitivity of 100%, specificity of 93.8%, and an accuracy of 92.9% for detection of acute fractures of the thoracic spine.

**CONCLUSION**

Findings from this study show that bone marrow edema and using a cut-off value of 43.5HU in virtual non-calcium images reconstructed from dual-energy CT can be useful in the diagnosis of acute fractures of the thoracic spine.

**CLINICAL RELEVANCE/APPLICATION**

Virtual non-calcium images derived from DECT allow detection of bone marrow edema and, therefore, provide a convenient and accurate modality for detection and characterization of acute fractures.

**SSE06-05  Diagnostic Value of CT in Patients with Suspected Thoracic Spine Fractures Due to Minor Trauma**

Monday, Nov. 30 3:40PM - 3:50PM Location: N227

Participants

Murat Karul, MD, Hamburg, Germany (Presenter) Nothing to Disclose

Amelie Hoffmann, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

Gerhard B. Adam, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

Jin Yamamura, MD, Hamburg, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate the accuracy of biplane radiography in the detection of thoracic spine fractures in patients with minor trauma using computed tomography (CT) as the reference.

**METHOD AND MATERIALS**

130 consecutive patients (71 males; 59 females; mean age 69 ± 22.7 years; range 18-95 years) with minor trauma of the thoracic spine and low to moderate back pain on physical examination were included retrospectively. All had undergone biplane radiography first, followed by a CT scan in a time frame of 4 days because of aggravation of their symptoms. A contingency table and the Chi-square test (X2) were used to compare both diagnostic methods.

**RESULTS**

CT revealed 95 fractures in 71/130 patients (54.6%). Most fractures were diagnosed in the thoracolumbar junction (n=27). Biplane radiography was true positive in 42/130 patients (32.3%), false positive in 20/130 patients (15.4%), true negative in 42/130 (32.3%), and false negative in 26/130 patients (20%), showing a sensitivity of 61.8%, a specificity of 67.7%, a positive predictive value of 67.7%, and a negative predictive value of 61.8%. None of the fractures missed on biplane radiography was unstable. Presence of a fracture on biplane radiography was highly statistical significant, if this was simultaneously proven by CT (X2 = 11.3; p= 0.00077).

**CONCLUSION**
Sensitivity and specificity of biplane radiography in the diagnosis of thoracic spine fractures in patients with minor trauma are low.

CLINICAL RELEVANCE/APPLICATION

Considering the wide availability of CT that is usually necessary for taking significant therapeutic steps, indication for x-ray in minor trauma patients should be very restrictive.

SSE06-06 140kVp Spectral Filtration CT of the Cervical Spine: Reduced Artifact and Reduced Radiation Dose in the Emergency Setting

Monday, Nov. 30 3:50PM - 4:00PM Location: N227

Participants
Dennis Parhar, BSc, Vancouver, BC (Presenter) Nothing to Disclose
Luck J. Louis, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Tim O'Connell, MD, Meng, Vancouver, BC (Abstract Co-Author) President, Resolve Radiologic Ltd; Speake, Siemens AG
Savvas Nicolaou, MD, Vancouver, BC (Abstract Co-Author) Nothing to Disclose
Patrick D. McLaughlin, FFRRCSI, Cork, Ireland (Abstract Co-Author) Speaker, Siemens AG

PURPOSE

Attempts to reduce radiation exposure at the cervical spine are frequently and negatively limited by beam hardening artifact and photon starvation at the cervicothoracic junction. The purpose of this study is to compare image quality and radiation dose of conventional 120kVp CT versus a novel spectral filtration CT (SFCT) mode, which uses 140kVp and an added tin filter to produce small quantities of highly penetrating photons, in acute trauma patients.

METHOD AND MATERIALS

20 consecutive patients underwent SFCT of the cervical spine (Sn140kV, 450refmAs, 40x0.6mm) using a dual source 128-slice CT system (Definition FLASH; Siemens Healthcare, Forchheim, Germany) and were compared to 20 patients who underwent conventional 120kVp CT. Attenuation was measured by placing circular regions of interest on the spinal cord at the C2, C5, and C7 levels. Statistical analysis of this data was performed using Mann-Whitney U tests. Image quality was graded by 2 readers using a semi-objective 4-point scoring system at the same spinal levels. These results were subjected to Wilcoxon Signed-Rank Test for statistical analysis.

RESULTS

The findings show a statistically significant decrease in the radiation dose when using SFCT versus conventional 12-kVp CT. SFCT reduced the computed tomography dose index (CTDI) by 47.4% (-12.5, p<0.0022) and the dose length product (DLP) by 43.3% (-246.7, p<0.0022). Moreover, subjective analysis of image quality demonstrated a statistically significant improvement in image quality at both the C5 and C7 level due to reduction of bone hardening artifact (median=3, p<0.0313).

CONCLUSION

The findings show a significant objective decrease in radiation dose as well as a significant subjective improvement in image quality through reduction of bone hardening artifact in spectral CT versus conventional CT. These results indicate that spectral filtration CT shows great promise in imaging of the cervical spine.

CLINICAL RELEVANCE/APPLICATION

Given the large number of C-Spine imaging referrals, a young patient base, and the potentiality of serious injury, there is a necessity for high-quality, reduced-dose C-Spine imaging in the ER setting.
RSNA Diagnosis Live™: 'Tic Tac D'Oh' - Test Your Diagnostic Skills at the Crack of Dawn

Tuesday, Dec. 1 7:15AM - 8:15AM Location: E451B

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Adam E. Flanders, MD, Penn Valley, PA (Presenter) Nothing to Disclose
Christopher G. Roth, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Sandeep P. Deshmukh, MD, Philadelphia, PA, (sandeep.deshmukh@jefferson.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
LEARNING OBJECTIVES

1) To discuss how MRI-based cartilage mapping techniques yield biomarkers of cartilage integrity, and discuss the technical requirements and current indications for clinical use of these methods. 2) To describe the emerging capabilities of high-resolution MR imaging to examine bone microarchitecture and its potential in providing biomarkers of bone strength. 3) To discuss potential applications of MR spectroscopy in musculoskeletal neoplasms and fat quantification of musculoskeletal tissues such as marrow and muscle.

ABSTRACT

There is strong incentive to increase the role of quantitative techniques in clinical musculoskeletal imaging, especially applications related to cartilage health, bone structure, tumor and metabolic imaging. This Hot Topic session will discuss clinical applications of biomarkers of cartilage integrity (T1rho, T2, T2* and dGEMRIC), bone structure by high-resolution MRI, and tissue metabolism (MR spectroscopy for tumor imaging, muscle and marrow fat content).

Sub-Events

SPSH30A T2, T2*, T1rho and dGEMRIC as Biomarkers of Cartilage Integrity

Participants
Thomas M. Link, MD, PhD, San Francisco, CA, (thomas.link@ucsf.edu) (Presenter) Research funded, General Electric Company; Research funded, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

LEARNING OBJECTIVES

1) To define how T2, T2*, T1rho and dGEMRIC quantitatively assess cartilage matrix composition. 2) To describe the requirements for applying these quantitative measurements to clinical imaging. 3) To critically assess previous clinical studies and list indications for using quantitative cartilage imaging biomarkers.

SPSH30B Bone Microarchitecture by MRI

Participants
Gregory Chang, MD, New York, NY (Presenter) Speaker, Siemens AG

LEARNING OBJECTIVES

1) To define bone microarchitecture and its contribution to bone strength and fracture risk. 2) To describe the technical requirements for MRI of bone microarchitecture, including hardware, pulse sequences, and image post-processing. 3) To provide an overview of clinical studies of MRI of bone microarchitecture.

SPSH30C MR Spectroscopy of the Musculoskeletal System

Participants
Martin Torriani, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To define how MR spectroscopy quantitatively measures tissue biochemistry. 2) To describe general guidelines for usage of MR spectroscopy in musculoskeletal clinical imaging, including technical factors, quantification/analysis and interpretation. 3) To assess the state-of-the-science in regards to the use of MR spectroscopy for musculoskeletal tissues.
**RC304**

**Musculoskeletal Series: Ultrasound**

**Tuesday, Dec. 1 8:30AM - 12:00PM Location: E450A**

**AMA PRA Category 1 Credits™:** 3.25
**ARRT Category A+ Credits:** 4.00

**Participants**
Marnix T. van Holsbeeck, MD, Detroit, MI, (marnix@rad.hfh.edu) (Moderator) Consultant, General Electric Company Consultant, Koninklijke Philips NV Stockholder, Koninklijke Philips NV Stockholder, General Electric Company Grant, Siemens AG Grant, General Electric Company
Jon A. Jacobson, MD, Ann Arbor, MI, (jjacobsn@umich.edu) (Moderator) Consultant, BioClinica, Inc; Royalties, Reed Elsevier; ; ;

**LEARNING OBJECTIVES**

1) The 'Ultrasound' Series Course will review musculoskeletal sonography through live instruction by expert refresher course instructors, interspersed with scientific presentations.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jon A. Jacobson, MD - 2012 Honored Educator

**Sub-Events**

**RC304-01  Elbow Ultrasound (Demonstration)**

**Tuesday, Dec. 1 8:30AM - 9:00AM Location: E450A**

**Participants**
Jon A. Jacobson, MD, Ann Arbor, MI (Presenter) Consultant, BioClinica, Inc; Royalties, Reed Elsevier; ; ;

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jon A. Jacobson, MD - 2012 Honored Educator

**RC304-02  Ultrasound of the Distal Biceps Brachii Tendon Using Four Approaches: Reproducibility and Reader Preference**

**Tuesday, Dec. 1 9:00AM - 9:10AM Location: E450A**

**Participants**
Shefali P. Kothary, MD, New York, NY (Presenter) Nothing to Disclose
Theodore T. Miller, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Gabrielle P. Konin, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Ogbonna K. Nwawka, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Yoshimi Endo, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Gregory R. Saboeiro, MD, New York, NY (Abstract Co-Author) Research funded, Terumo Corporation Speakers Bureau, Bioventus LLC

**PURPOSE**

To determine which sonographic appearance of the distal biceps tendon is preferred by readers and if images obtained by two different operators are reproducible.

**METHOD AND MATERIALS**

An IRB approved, HIPAA compliant prospective study was performed evaluating the distal biceps brachii tendon in 40 elbows in 20 volunteers. The subjects had no history of biceps injury or abnormality, and were without antecubital pain. There were 8 males and 12 females, ages 24 to 67 years (mean age of 37) with a body mass index (BMI) of 18.3 to 31.1 (mean BMI of 24.7). Distal biceps brachii tendons of each subject were scanned in long axis using a 6-15 MHz linear transducer on a GE Logic 9 by two experienced musculoskeletal radiologists independently (operator A and B) using four different approaches: anterior, lateral, medial, and posterior. Five musculoskeletal radiologists independently reviewed the static images, and ranked the 4 approaches based on overall combination of echogenicity of the tendon, visualized length, and visualization of the insertion.

**RESULTS**

The appearance of the distal tendon obtained via the medial approach was preferred by readers in 78.5% (314/400) of cases (74.5% performed by operator A and 82.5% performed by operator B). The anterior approach was preferred by readers in 19.25%
(77/400) of cases (24.0% by operator A and 14.5% by operator B). The lateral approach was preferred in 2.25% (9/400) of cases (1.5% by operator A and 3% by operator B), and the posterior approach was never preferred.

CONCLUSION

The appearance of the distal biceps brachii tendon using the medial approach is preferred by readers and is reproducible between different operators.

CLINICAL RELEVANCE/APPLICATION

When sonographically evaluating the elbow for suspected pathology of the distal biceps tendon, the medial approach should be the primary method of visualization, supplemented by the other approaches if necessary.

RC304-03 Shear Wave Elastography (SWE) Improves Treatment Monitoring of Patients with Tendinopathies

Tuesday, Dec. 1 9:10AM - 9:20AM Location: E450A

Participants
Timm Dierichs, Aachen, Germany (Presenter) Nothing to Disclose
Christian K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Valentin Quack, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Simone Schrading, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE

It has been shown that SWE is useful for the evaluation of tendoninopathies. Purpose of this prospective clinical study was to analyze the correlation between clinical symptoms and tendon stiffness in patients undergoing treatment of tendinopathies. Aim is to establish SWE as tool for monitoring tendon healing under therapy.

METHOD AND MATERIALS

Prospective study in 35 patients with 47 symptomatic tendons (17 achilles, 15 patellar tendons and 15 humeral epicondylitis) who underwent a standardized multi-modality US protocol consisting of B-mode US, power Doppler (PD-US), and SWE, using a high-resolution linear 15 MHz probe (Aixplorer, Supersonic). All patients underwent this multi-modality US protocol three times: prior to any therapy, after 4 week of therapy and after 6 months of therapy. At each visit, patients were seen by an orthopedic surgeon who ranked the patients’ clinical symptoms by standardized orthopedic scores (VISA-A, VISA-P, DASH). Clinical scores of symptom severity were correlated with ultrasound findings by using the Spearman correlation.

RESULTS

Clinical scores revealed symptom relief in 46.8% (22/47) of patients after 4 weeks and in 68.0% (32/47) after 6 months. A change of structural tendon abnormalities as observable by B-mode US was detectable in one single patient after 4 weeks (1/22; 4.5%) as well as after 6 months (1/32; 3.1%). A decrease in neovascularization as observed by PD-US was detectable in 9 patients after 4 weeks (9/22; 40.9%) and in 13 patients after 6 months (13/32; 39.4%). An increase in tendon stiffness as determined by SWE was found in 18 patients after 4 weeks (18/22; 81.8%) and in 28 patients after 6 months (28/32; 90.6%). At quantitative analysis, the 32 patients whose clinical symptoms improved exhibited an increase of mean SWE values by 23 kPa (from 41.7 to 64.2 kPa) after 4 weeks and by 64 kPa (from 41.7 to 105.5 kPa) after 6 months. Clinical scores correlated poorly with findings at B-mode (r = 0.24), moderately with findings at PD-US (r = 0.59), and perfectly with findings made at SWE (r = 0.80).

CONCLUSION

Shear wave elastography correlates better with clinical symptoms and seems to display tendon healing better and earlier than B-mode and Power Doppler.

CLINICAL RELEVANCE/APPLICATION

Shear wave elastography appears to be useful to guide treatment and to develop new treatment approaches in patients with tendinopathies.

RC304-04 Delayed Onset Muscle Soreness (DOMS) after Eccentric Resistance Training of the Elbow Flexor Muscles: Temporal Evolution of MRI, Diffusion Tensor Imaging and Ultrasound Shear-Wave Elastography Findings

Tuesday, Dec. 1 9:20AM - 9:30AM Location: E450A

Participants
Christoph A. Agten, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Florian M. Buck, MD, Langnau am Albis, Switzerland (Abstract Co-Author) Nothing to Disclose
Linda Dyer, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (Abstract Co-Author) Advisory Board, Siemens AG; Consultant, Medtronic, Inc
Andrea Rosskopf, MD, Zurich, Switzerland (Presenter) Nothing to Disclose

PURPOSE

To evaluate the appearance of DOMS over time using fluid-sensitive and diffusion-weighted MRI sequences, diffusion-tensor imaging(DTI) and ultrasound(US) shear-wave elastography in healthy volunteers.

METHOD AND MATERIALS

Five men (m; mean age 39.6±4.6 years) and 5 women (w; 30.6±13.5 years) underwent unilateral eccentric resistance training of the elbow flexor muscles consisting of 3 sets (12 repetitions each) of individually adapted maximal weights. 1.5T-MRI was done before and after (15 min; 1, 3, and 7 days) the training, including fluid-sensitive sequences, diffusion-weighted-sequences, and DTI of the distal upper arm. Evaluated MRI parameters were: visible muscle edema (vME; mild, moderate, severe), cross-sectional muscle area (CSMA), muscle diffusion restriction (ADC:10-6mm²/sec), fractional anisotropy (FA). US shear-wave elastography of the brachial muscle was performed before and after(15 min; 0.5; 1, 2, 3 and 7 days) the training. Subjective DOMS-evaluation parameters were assessed: pain (scale 0-10), tension feeling, extension deficit.
RESULTS

In men mean vME was moderate and peaked 3 days post training, for women mean vME was mild and peaked 2 days post training. CSMA was highest 3 days post-training in men(+9%) and women(+11%). Maximum mean ADC value was found after 3 days in men(1809; before training:1530) and women(1742; before:1476). Mean FA dropped from 361(m) and 389(w) to a minimum of 252 and 321 respectively after 3 days.US-elastography revealed an increase of mean shear wave velocity values(MSWV) after training in men(before training:3.0 m/s±0.3; peak 15min post:4.0 m/s±0.9) and in women(before:2.8± 0.4;peak 1 day post:3.2 m/s±0.4). In men a significant positive correlation was found between ADC of M. brachialis and MSWV(r=0.92,p=0.028) and a significant negative correlation between maximal FA of flexor muscles and pain (r=-0.99;p<0.001) was seen. Maximal pain level(m:3±1,w:4±3) and maximal extension deficit was achieved after 2 days. Tension feeling started 15min post-training and normalized after 7 days.

CONCLUSION

Muscles changes can be detected 15 minutes after eccentric resistance training using diffusion-MRI and US shear-wave elastography. FA correlates negatively with subjective pain symptoms in men. ADC shows changes earlier than fluid-sensitive-MR sequences.

CLINICAL RELEVANCE/APPLICATION

ADC and US-elastography are recommended when looking for very early muscle changes after eccentric muscle exercise.

RC304-05 Ultrasound of the Post-arthroplastic Hip

Tuesday, Dec. 1 9:30AM - 9:40AM Location: E450A

Participants
David Robinson, BSC, Hampton East, Australia (Presenter) Nothing to Disclose
Steven Lee, FRANZCR, Windsor, Australia (Abstract Co-Author) Nothing to Disclose
Paul Marks, FRANZCR, Box Hill, Australia (Abstract Co-Author) Nothing to Disclose
Michal Schneider, PhD, Clayton, Australia (Abstract Co-Author) Nothing to Disclose

PURPOSE

Ultrasound has been recommended as an imaging modality in the follow-up of hip replacement surgery. However, no descriptions of typical ultrasound appearances of the major pathologies that may afflict the hip replacement have been published to date. We set out to characterize ultrasound findings of the post-arthroplastic hip.

METHOD AND MATERIALS

Patients presenting to the department for routine follow-up imaging of their hip prosthesis were consecutively recruited. Ultrasound imaging was performed of the anterior and posterior prosthesis and of the iliopsoas bursa and tendon.

RESULTS

Fifty two patients were prospectively recruited with a mean (±SD) age of 60.4 (±12) years. Twelve patients had bilateral hip prostheses, giving 64 hips for analysis. There were 45 Birmingham hip resurfacings (BHR), ten MITCH, five Articular Surface Replacement (ASR), three Total Hip Replacements (THR) and one ADEPT hip resurfacing. Mean age of the prosthesis in situ was 8.2 years. Ultrasound was able to reliably image the soft tissues of all hips. The average (±SD) maximal antero-posterior (AP) synovial thickness was 6.5 (± 7) millimeters and the AP Iliopsoas tendon measurement was 4.8 (± 0.94) millimeters. Forty four hips presented with normal ultrasonic appearances. There were 15 iliopsoas bursal effusions ranging from mild (a trace of fluid surrounding the ilipsoas tendon), to very large (fluid-filled masses anterosuperior to the prosthesis). Four hips showed enlargement of the prosthesis-to-bone "step" possibly indicating the process of osteolytic femoral neck thinning. One hip demonstrated mild synovial thickening at the anterior recess.

CONCLUSION

Ultrasound is able to detect and evaluate a range of soft tissue pathologies about the post-prosthetic hip, such as fluid or effusion of the iliopsoas bursa, iliopsoas tendon thickening and heterogeneity, synovial thickening of the anterior and posterior hip joint recesses. Ultrasound imaging has an important role to play in the follow-up of the post-prosthetic hip.

CLINICAL RELEVANCE/APPLICATION

Ultrasound of the post-prosthetic hip can demonstrate abnormalities during follow up and may serve as a useful tool in the management of patients with hip replacements.

RC304-06 Hip Ultrasound (Demonstration)

Tuesday, Dec. 1 9:40AM - 10:10AM Location: E450A

Participants
Marnix T. van Holsbeeck, MD, Detroit, MI, (marnix@rad.hfh.edu) (Presenter) Consultant, General Electric Company Consultant, Koninklijke Philips NV Stockholder, Koninklijke Philips NV Stockholder, General Electric Company Grant, Siemens AG Grant, General Electric Company
Kathy Quenneville, BS, RT, Commerce Township, MI, (kathyq@rad.hfh.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Demonstrate the osseous landmarks that guide the diagnostic work up of an adult hip. 2) Practice a step by step approach in the evaluation of anterior hip pain. 3) Rationalize the individual steps for the hip dynamic examination.

RC304-07 Ankle and Foot Ultrasound (Demonstration)

Tuesday, Dec. 1 10:20AM - 10:50AM Location: E450A

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (Presenter) Speaker, General Electric Company; Equipment support,
The treated Achilles tendons showed progressive stiffening, along with improvement in clinical findings up to one year follow-up. SE and CD US did not show a significant correlation \( r =-0.041, p <0.001 \) whereas a significant change in the distribution of tendons with hypoechogenicities was only observed at 12 months in comparison to baseline \( p <0.001 \). At 12 months evaluation, none of the tendons regained a normal echotexture despite \( p <0.001 \). The proportion of tendons with neovascularities were significantly reduced at 6 months \( p <0.001 \) and 12 months \( p =0.006 \) and 12 months \( p <0.001 \). The mean strain ratio values were 2.16 (±1.42) at baseline, 2.03 (±0.67) at 4-6 weeks, 1.81 (±0.62) at 6 months and 1.19 (±0.34) at 12 months with a significant reduction observed at 6 months \( p =0.006 \) and 12 months \( p <0.001 \).

### RESULTS

The strain ratio of target muscle was higher than adjacent muscle (mean 3.14; range, 0.95-5.93). There was no significant agreement between the strain ratios of the color parameters and the biochemical data. Sixteen of 17 specimens (94.1\%) were confirmed by inflammatory myopathies. One lesion (5.9\%) shows well preserved muscle fiber with few lymphocytes infiltration.

### CONCLUSION

Muscle hardness as semi-quantitative measured by SEL, was increased in cases of inflammatory myopathies. The correlation between strain ratio from the elastographic images and the pathologic data suggest that SEL could be an important tool not only in the diagnosis but also in the management of the patients with inflammatory myopathies.

### CLINICAL RELEVANCE/APPLICATION

High strain ratio could add knowledge regarding early development of inflammatory myopathy, which might have an impact on guidance before US-guided procedure to improve success rate for biopsy.
The treated Achilles tendons showed progressive stiffening, along with improvement in clinical findings up to one year follow-up. SE using strain ratio could be a promising supplementary tool for monitoring the progress of Achilles tendon healing after treatment.

**CLINICAL RELEVANCE/APPLICATION**

The supplementation of SE to conventional US may improve the specificity in routine monitoring of Achilles tendon healing and provide more objective data for safer return to activities.

**RC304-10 Comparison of Ultrasound Guided Collagenase Clostridium Histolyticum Injections and Blinded Injections for the Treatment of Dupuytren’s Contracture**

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E450A

**Participants**
Eva Llopis, MD, Valencia, Spain (Presenter) Nothing to Disclose
Luis Aguillera, MD, Alzira, Spain (Abstract Co-Author) Nothing to Disclose
Rosana Perez, MD, Alzira, Spain (Abstract Co-Author) Nothing to Disclose
Victoria Higuera, MD, Alzira, Spain (Abstract Co-Author) Nothing to Disclose
Elena Belloch, Alzira, Spain (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Collagenase clostridium histolyticum (collagenase) injections have been proven an effective, safe treatment for Dupuytren disease, an alternative to fasciectomy. Our objective was to analyze the additional value of US guided injections and to study the correlation of US and MR for the diagnosis of Dupuytren disease.

**RESULTS**

All patients were male but 2; average age 66.5yo; 5th finger was the most frequently affected, (group A 50% and B 60.41%) pretendinous cord was the most frequent 71% and 52% (group A/B) followed by lateral cord 13% and 28.6% (group A/B). US appearance is variable (combined 45%, hyperechogenic 36%, hypoechogenic 18%), mean distance from skin 1.8mm, average size of the cord 3.9mm (1.6-5.3mm). On T1WI MR is mainly low SI (36%) or combined 45%. Complete extension (<5% contraction) was achieved in 36.97% and 57.14% (group A/B), the percentage of correction was 70% and 76 (group A/B), p=0.095, being statistically significant for PIP, 54%/76% (group A/B), p=0.020. VAS in 68% and 76% (group A/B), failure in 32% and 23% (group A/B). No nerve damage or tendon rupture occurred. Skin complications 32% and 23.8% (group A/B).

**CONCLUSION**

US guidance offers better results and slightly decrease of skin complications than blind collagenase injection being a good alternative to fasciectomy, although not statistically significant. More significant results are seen on lateral cords on PIP contractions, where US is recommended. MR and US can identify collagenous and cellular components, thus potentially improving effectiveness, however US is more variable.

**CLINICAL RELEVANCE/APPLICATION**

US has added value in targeting Dupuytren cords for injection of collagenase with better outcome and lower rate of complications especially for lateral cords on PIP contractions.

**RC304-11 Ultrasound-Guided Treatment of Refractory Chronic Plantar Fasciopathy: A Randomized Controlled Pilot Study of Platelet-Rich Plasma versus Corticosteroid Injection**

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E450A

**Participants**
Kenneth S. Lee, MD, Madison, WI (Presenter) Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier
John J. Wilson, MD, MS, Madison, WI (Abstract Co-Author) Nothing to Disclose
Sarah Kohn, Madison, WI (Abstract Co-Author) Nothing to Disclose
Elizabeth Piovanich, Madison, WI (Abstract Co-Author) Nothing to Disclose
Jeffrey Swick, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Ray Vanderby, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To investigate if ultrasound-US-guided platelet-rich plasma (PRP) injection is effective for treating moderate to severe refractory chronic plantar fasciopathy (PF) compared to standard of care corticosteroid (SOC) injection.

**METHOD AND MATERIALS**

Inclusion criteria were met, which required unilateral PF, failed conservative therapy, and VAS pain level of at least 5 of 10 for at least 6 months duration. 44 consecutive subjects were randomized into two groups, PRP and SOC. Subjects received either a single injection of autologous PRP or a single injection of triamcinolone 40 mg at week 0. VAS pain levels validated clinical surveys (FAAM/SANE), and US changes of PF thickness, hypoechogenicity (grade 0-3), and hyperemia (grade 0-3) were obtained at week 0 (pre-injection), week 16 and 32. Analysis of covariance was used for statistical analysis. Statistical significance was determined at p-value<0.05.

**RESULTS**

21 PRP subjects (mean age 47.8 yrs; range 30-64), M:F(4:17) and 23 SOC subjects (mean age 49.2 yrs; range 30-64), M:F(7:16) completed the 32-week study from March 2011-July 2014. No loss to follow-up. Baseline VAS pain levels were not significant (6.93 in PRP vs 6.63 in SOC; p=0.4). At week 16 and 32, both groups showed improvement in VAS pain levels compared to baseline, but PRP showed greater improvement than SOC over time (6.93 to 2.64 to 1.7; p=0.00). SOC pain level improved initially at week 16 but rebounded by week 32 (3.28 to 4.77; p=0.002). FAAM scores improved for both groups (p<0.001) but the PRP group improved by 12.6 more points by week 32 (p=0.02). SANE scores showed improving trend over time consistently favoring PRP (p=0.006). 132 US exams performed. Baseline US changes were not significant except for hypoechogenicity (2.80 in PRP vs 1.79 in SOC; p=0.002). PF thickness decreased (mean of 0.33 mm; p<0.001) in both groups but no difference between groups (p=0.74). PRP showed greater echotexture...
improvement than SOC over time (decrease of 0.42/visit, SD 0.13 in PRP vs 0.004/visit in SOC; p=0.003). Hyperemia did not change over time (0.86 for PRP vs 0.81 for SOC, p = 0.80). There were no complications.

CONCLUSION

US-guided PRP injection may be an effective treatment option for refractory chronic PF compared to corticosteroid injection. Larger multi-armed studies are now needed to establish a new standard of care treatment algorithm.

CLINICAL RELEVANCE/APPLICATION

PRP is more effective than corticosteroid injection for the long-term treatment of refractory chronic plantar fasciopathy.

RC304-12 Ultrasound-guided Interventions

Tuesday, Dec. 1 11:30AM - 12:00PM Location: E450A

Participants
Kenneth S. Lee, MD, Madison, WI (Presenter) Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier

LEARNING OBJECTIVES

View learning objectives under main course title.
**Effect of Biopsy Approach on Rate of Culture Positivity in Patients with Spinal Osteodiskitis**

**PURPOSE**
To compare the rate of culture positivity among 3 different methods of spine biopsy (transpedicular, disk, and paraspinal approaches) in patients with suspected osteodiskitis. A transpedicular approach has been advocated by some as it samples the subchondral bone where osteodiskitis begins, however culture positivity rates for osteomyelitic bone samples elsewhere in the body have been shown to be low.

**METHOD AND MATERIALS**
Patient charts and imaging from a five year period were retrospectively reviewed. We included only patients who had a high probability of osteodiskitis based on MRI and clinical findings. The transpedicular (TP) approach was categorized as an approach across the pedicle sampling predominantly subchondral bone with a variable amount of disk material obtained. The disk approach was defined as advancement of the needle directly into the disk from a posterolateral approach for aspiration and/or core biopsy. The paraspinal (PS) approach was defined as advancement of the needle into the abnormal paraspinous soft tissues adjacent to the abnormal level for aspiration and/or core biopsy. In patients where multiple access routes were used, the culture results from each route were isolated and evaluated separately. Fisher's exact test was used to compare the culture positivity rates among different approaches.

**RESULTS**
54 CT guided biopsy procedures (in 52 patients) were performed. Culture positivity rates for the different approaches were 6/27 (22%) for TP, 3/16 (19%) for disk, and 7/11 (64%) for PS. The positive culture rate was significantly better for PS compared to the TP (p=0.0244) or disk (p=0.0402) approach. No significant difference was seen in culture positivity between the TP and disk approaches (p=1.0).

**CONCLUSION**
The PS approach in our data set yielded the highest proportion of positive culture results, statistically different than the other methods. This contradicts earlier suggestions that the paraspinal soft tissues are usually sterile.

**CLINICAL RELEVANCE/APPLICATION**
Physicians treating patients with osteodiskitis often request biopsy for cultures and sensitivity in order to provide targeted antibiotic therapy; sampling the abnormal paraspinous soft tissues adjacent to suspected osteodiskitis may have a higher chance of producing positive culture results when compared to sampling bone or disk.

**MRI Evaluation of Bipolar Bone Loss Using the On-Off Track Method: A Feasibility Study**

**PURPOSE**
To see if the simultaneous evaluation of Hill-Sachs lesions and glenoid bone loss on MRI with the On-Off track (OOT) method can be used to predict engagement during arthroscopy.

**METHOD AND MATERIALS**
Seventy-five consecutive patients (60 males, 15 females) with a history of prior anterior shoulder instability who underwent preoperative MRI of the shoulder and arthroscopy at our institution were reviewed. A total of 76 MRIs were included (one patient had bilateral MRIs and arthroscopy). Two readers reviewed the MRI of each patient blindly and independently, using the OOT method to predict engagement. The OOT method consisted of estimating the Hill-Sachs index and glenoid track using 2D MR imaging; no 3D imaging was used. If the Hill-Sachs index was larger than the glenoid track, then the patient was considered on-track and at increased risk for engagement. If the Hill-Sachs index was smaller than the glenoid track, then the patient was considered off-track and at no increased risk for engagement. These results were compared to the findings related to engagement seen during arthroscopy, performed by one of seven orthopaedic surgeons. Statistical analysis included Fisher exact test, logistic regression and receiver operating characteristic (ROC), and intra-class correlation coefficients (ICC).
RESULTS
Using the OOT method on MRI, 13 of the 18 engaging (off-track) lesions (72.2%; sensitivity) were predicted correctly. Of the 58 shoulders that did not engage (on-track), 51 (87.9%; specificity) were predicted correctly. Overall, the accuracy for the OOT method was 84.2% with a positive predictive value of 65% and negative predictive value of 91.1%.

CONCLUSION
Our study has demonstrated that the On-Off track method can be used on MRI to accurately assess the bipolar bone loss seen in the patient with anterior shoulder instability in terms of predicting engaging/off-track lesions.

CLINICAL RELEVANCE/APPLICATION
The On/Off track status can be used in the preoperative setting to help guide the type of stabilization procedure performed on the patient with anterior shoulder instability.

MK344-SD-TUA3
MR, Arthroscopic, and Cadaveric Correlation of Articular Cartilage of the Femoral Condyles - Identifying the Hidden Zones of the Far Posterior Cartilage Not Visible during Routine Arthroscopy

Station #3

Participants
Joseph P. Liu, MD, Los Angeles, CA (Presenter) Nothing to Disclose
Mark J. Sando, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
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Orr Limvisvasti, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
John V. Crues III, MD, Los Angeles, CA (Abstract Co-Author) Stockholder, RadNet, Inc Officer, RadNet, Inc

PURPOSE
Our study aims to identify femoral condylar articular cartilage seen via routine arthroscopy compared to MRI. Arthroscopy has been used as gold standard for MR cartilage research, yet no standardized nomenclature for cartilage localization has been established. The femoral condylar cartilage is visualized in its entirety on MRI. The same is not true for routine arthroscopy performed using standard portals with 90° of standard maximum range of flexion. We describe arthroscopically hidden areas of cartilage and provide an option for standardized terminology.

METHOD AND MATERIALS
Six cadaveric specimens were scoped using the standard portals in flexion ranging from 30° to 120°. Suture anchors were inserted into the femoral condyles for MR correlation. The specimens were then scanned with multiplanar T1 and T2 sequences including 3D acquisitions on a 3.0 T magnet in extension. After imaging, the specimens were dissected for measurements. Distances between the suture anchors were made using all three methods. Anatomic landmarks and angles on MRI were also recorded.

RESULTS
All six specimens demonstrated that routine arthroscopy show only a small portion of the articular cartilage proximal (superior) to the menisci. The average distances of the 90° anchors to the posterior margins of the cartilage were 38.4 mm and 32.4 mm on dissection and 35.2 mm and 28.7 mm on MR, medial and lateral respectively. Only an additional 5.8 mm medially and 6.8 mm laterally were visible beyond the 90° anchors arthroscopically. This indicates that 85.8% of the medial and 80.8% of the lateral cartilages seen on MR proximal to the menisci are not visible. Arthroscopy with additional flexion to 120° decreases the hidden areas to 53.7% medially and 43.7% laterally. On MR, most of the 90° and 120° anchors lie between the landmarks of the posterior margins of the cartilage proximally and the menisci distally.

CONCLUSION
Our study shows that >80% of the articular cartilages seen on MRI proximal to the menisci are not visible on routine arthroscopy. We propose this posterior articular cartilage be called the "hidden zone".

CLINICAL RELEVANCE/APPLICATION
Routine arthroscopy fails to visualize >80% of the posterior articular cartilages proximal to the menisci. Cartilage research using arthroscopy as gold standard should exclude these hidden zones.

MK345-SD-TUA4
Reliable Measurement of the Femoral Head-neck Alpha Angle Utilizing Ultrasound

Station #4

Participants
David Robinson, BSC, Hampton East, Australia (Presenter) Nothing to Disclose
Steven Lee, FRANZCR, Windsor, Australia (Abstract Co-Author) Nothing to Disclose
Paul Marks, FRANZCR, Box Hill, Australia (Abstract Co-Author) Nothing to Disclose
Michal Schneider, PhD, Clayton, Australia (Abstract Co-Author) Nothing to Disclose

PURPOSE
The femoral head-neck alpha angle is a method of quantifying the degree of femoral head asphericity in patients suspected of cam-type femoroacetabular impingement. The measurement was first performed using Magnetic Resonance Imaging (MRI), and more recently, three-dimensional Computed Tomography (3DCT). We set out to determine if the alpha angle could be reliably measured using ultrasound of the anterosuperior femoral head-neck junction.

METHOD AND MATERIALS
Volunteers were recruited among patients presenting for three-dimensional computed tomography (3DCT) of the hip. Alpha angles were calculated following the departmental protocol by institutionally-accredited radiographers. Patients were then imaged using ultrasound and the alpha angle calculated from the ultrasound image by a sonographer blinded to the 3DCT result. Statistical comparison of the two methods was performed with the Bland-Altman test using SPSS (version 21.0, Chicago, USA) and a p < 0.05
RESULTS
Twenty-three patients were recruited. Eight patients were bilateral examinations, providing 31 hips for analysis. Average patient age was 40 years (19-74 years). The difference between CT and Ultrasound measured alpha angles was not statistically different (p=0.243). Mean (± SD) (range) measurements for CT and Ultrasound were 61.31 (± 14.58) (37.7 - 90.9) and 64.69 (± 12.53) (44.4 - 101.6) respectively. The mean difference between the two methods was -3.38 degrees (95%CI -9.2 - 2.4 degrees).

CONCLUSION
Ultrasound imaging can provide an accurate quantitative measure of femoral head asphericity, in the absence of 3DCT imaging.

CLINICAL RELEVANCE/APPLICATION
Ultrasound can reliably calculate the femoral head-neck alpha angle when 3DCT is not indicated or not available.

PURPOSE
To evaluate the computer-based method using temporal subtraction in carpal joints of rheumatoid arthritis (RA) patients, which can detect the difference in joint space between two images as the joint space difference index (JSDI).

METHOD AND MATERIALS
Twenty-seven rheumatoid arthritis patients (24 females and 3 males, mean age 60 years) on Tocilizmab were enrolled. Radiographs were obtained at baseline and at 1 year. The joint space narrowing (JSN) of a total of 229 carpal (3rd carpometacarpal, 5th carpometacarpal, scaphoid-trapezium, scaphoid-capitate, and radius-scaphoid) joints on bilateral hand radiographs was assessed by our computer-based method, setting the Sharp/van der Heijde method as the gold standard. We performed three examinations to confirm that the JSDI reflects the chronological change in joint space width. We compared the JSDI of joints with JSN progression (increase in Sharp/van der Heijde score) in the follow-up period with those without JSN progression. In addition, we examined whether there is a significant difference in JSDI in terms of laterality or topology of the joint.

RESULTS
The JSDI of joints with JSN progression was significantly higher than those without JSN progression (Mann-Whitney U test, p < 0.001). There was no statistically significant difference in the JSDI between left and right carpal joints, which was analyzed for 5 different joints altogether and each joint separately (Mann-Whitney U test, p > 0.05 respectively). There was no statistically significant difference in JSDI among different joints (Kruskal-Wallis test, p = 0.155). In all examinations, the results of the computer-based method were consistent with those of the Sharp/van der Heijde method as the gold standard.

CONCLUSION
These results suggest that our computer-based method may be useful to recognize the joint space narrowing progression on radiographs in carpal joints.

CLINICAL RELEVANCE/APPLICATION
The computer-based temporal subtraction method can detect the joint space narrowing progression in the wrist, which is the single most predilection site for rheumatic diseases.

PURPOSE
To quantify microcirculation alteration in the calf muscle of type 2 diabetes mellitus (T2DM) rhesus monkey by new noncontrast skeletal muscle MR perfusion and oximetry techniques.

METHOD AND MATERIALS
7 adult T2DM rhesus monkeys without peripheral artery disease (HbA1c = 7.75 ± 2.95%) and 2 normal adult rhesus monkeys (14±3 years old; male 7) were examined. The skeletal muscle blood flow (SMBF) and oxygen extraction fraction (SMOEF) measurements were performed with an air-cuff protocol (4 min at rest, 4 min inflation, and 4 min deflation periods) on a 3.0T Siemens Trio scanner. The cuff was placed on the mid-thigh above the right knee. One section was centered at the largest cross-section of the calf for SMBF measurements, but 22 sections in the calf muscle was measured for the SMOEF measurements. The SMBF measurements were performed with an air-cuff protocol (4 min at rest, 4 min inflation, and 4 min deflation periods) on a 3.0T Siemens Trio scanner. The cuff was placed on the mid-thigh above the right knee. One section was centered at the largest cross-section of the calf for SMBF measurements, but 22 sections in the calf muscle was measured for the SMOEF measurements. The SMOEF
(m/min/100g) was measured using an arterial spin labeling method only during the recovery period for hyperemic flow with a temporal resolution of 20 sec. The SMOEF maps were measured using a susceptibility-based MRI technique with a temporal resolution of 4 min. A region of interest was placed on the triceps surae muscle of the maps for quantitative SMBF and SMOEF measurements.

RESULTS
Elevated flow was clearly visualized in the SMBF maps within one minute immediately after the cuff deflation. This hyperemic SMBF in diabetes monkeys were significantly lower than in normal monkeys (40.4±7.7 vs. 73.1±27.6 m/min/100g, P<0.05), indicating significantly impaired blood supply. Due to some bulk motion artifacts, SMOEF data from 5/7 diabetes and 1/2 normal monkeys was used for analysis. The SMOEFs in one normal monkey were 0.55 at rest, 0.77 during inflation, and 0.49 during deflation periods. In contrast, respective mean SMOEF in 5 diabetes monkeys were 0.48 ± 0.05, 0.51 ± 0.1, and 0.43 ± 0.08. Therefore, the changes in SMOEF from resting to cuff in the normal monkey was 39.4%, which is much larger than 6.6% in diabetes monkeys, indicating impaired oxygen metabolism (Figure).

CONCLUSION
Non-contrast MRI microcirculation mapping techniques can quantitatively demonstrated that the peripheral perfusion and oxygenation were significantly impaired in T2DM rhesus monkeys without peripheral artery disease.

CLINICAL RELEVANCE/APPLICATION
New noncontrast skeletal muscle MR perfusion and oximetry techniques can noninvasively quantify the impaired microcirculation during a cuff exercise in T2DM without peripheral artery disease.

MK348-SD-TUA7
Vertebral Bone Marrow Fat Content Measured by MRI is Associated with Bone Mineral Density: A Cadaveric Study Using Micro-CT

Station #7

Participants
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PURPOSE
Magnetic resonance spectroscopy (MRS) has shown a negative correlation between marrow fat and bone mineral density (BMD). The purpose of this study was to validate the relationships of vertebral marrow fat obtained by a clinically available fat-quantification method with BMD and bone strength in a cadaveric study.

METHOD AND MATERIALS
Fresh human L1 and L2 vertebral bodies were obtained from 10 adult cadavers. Vertebrae were scanned by 3-T MRI (Ingenia; Philips Healthcare) and micro-CT (TOSCANER-30000; Toshiba IT Systems Co.). Tissue BMD (tBMD) was obtained from micro-CT using a bone mineral reference phantom. Single-voxel MRS was acquired in vertebral bodies using a stimulated-echo acquisition mode sequence (TR, 2000 ms; TE, shortest). Two peaks (water at 4.67 ppm; fat at 1.3 ppm) were fitted and from the area under each peak, bone marrow fat fraction (FF by 1H MRS) was defined as fat/(fat + water) × 100 (%). Axial images for a six-echo mDIXON mode sequence (TR, 2000 ms; TE, shortest). Two peaks (water at 4.67 ppm; fat at 1.3 ppm) were fitted and from the area under each peak, bone marrow fat fraction (FF by mDIXON) was defined as fat/(fat + water) × 100 (%) using mDIXON-Quant software. Finite element modeling (FEM) using micro-CT data was performed using a 3D image analysis system. Correlations between FF by mDixon and 1H MRS, and relationships between tBMD, failure load, and FF by mDixon and 1H MRS were evaluated.

RESULTS
Values of FF assessed with mDIXON correlated with those from 1H MRS. Fat fractions were negatively associated with micro-CT-derived tBMD (p = -0.521, p = 0.04 for mDIXON; p = -0.550, p = 0.03 for 1H MRS). Micro-CT/FEM-derived failure load was positively associated with FF from mDIXON (p = 0.600, p = 0.01).

CONCLUSION
This study demonstrated that a higher level of marrow fat was associated with lower tBMD in the cadaveric spine, and that this relationship can also be assessed by the less time-intensive mDIXON technique in addition to 1H MRS. Compressive strength positively correlated with FF by mDIXON.

CLINICAL RELEVANCE/APPLICATION
We observed significant correlations between BMD, failure load and marrow fat content in the cadaveric spine. Measuring bone marrow fat by mDIXON may be useful for BMD and bone strength assessment.

MK119-ED-TUA8
Where is this Muscle Pain? MRI Imaging of Unusual Muscle Strains at the Level of the Pelvis

Station #8

Participants
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TEACHING POINTS

Hip pain is particularly frequent in both professional and amateur athletes. There are a significant number of muscle injuries at this region considered infrequent that may be overlooked by ultrasonography mainly because of its depth. There are even difficult to individualize in a conventional MRI causing an important source of impaired function in active individuals. The goal of this exhibit is to educate the radiologist about the complex anatomy of the pelvis in order to learn to recognize the clinical presentation and imaging findings of the muscle strains at this level.

TABLE OF CONTENTS/OUTLINE

- Introduction.
- MRI protocols.
- Pictorial and imaging anatomy of the pelvis.
- Review of 3T MRI cases collected for the last 5 years in our institution with original pictorial illustrations.
- Detailed pathologic diagnosis with mechanism of injury and clinical presentation.
- Examples include: Strains of iliopsoas, pectineus, obturator internus, externus, gracilis, piniforms, quadratus femoris, gluteus medius and gluteus minimus. Briefly discuss about typical muscle tears of the pelvis. Differential diagnosis. Conclusion.

MK172-ED-TUA9

MR Neurographic Features of Sciatic Neuropathy- A Pictorial Essay of Spectrum of Sciatic Nerve Pathologies

Station #9

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TEACHING POINTS

To elucidate Imaging biomarkers of Sciatic Neuropathy. Clinical EMNG and MR neurography features of Sciatic neuropathy. Common and uncommon causes of Sciatic Neuropathy are highlighted.

TABLE OF CONTENTS/OUTLINE

1. Sciatic nerve Compression and Etiologies of Extra spinal Sciatica at a Glance
   1.1 EXTRANEURAL
   1.2 INTRANEURAL
   1.3 INTRA PELVIC (neural foramina to Greater sciatic notch)
   1.4 EXTRA PELVIC (distal greater sciatic notch)
   1.4.1 TUMOR
   1.4.2 FIBROSIS
   1.4.3 TRAUMA
   1.4.4 DIABETIC AMYOTROPHY
   2. EXTRA PELVIC CAUSES.
   2.1 GLUTEAL ARTERY ANEURYSM
   2.2 PSEUDOANEURYSM
   2.3 GLUTEAL ABSCESS
   2.4 TUMOR
   2.5 PIRIFORMIS SYNDROME
   2.6 AVULSION FRACTURE OF ISCHIAL TUBEROSITY
   2.7 MIGRATION OF BROKEN TROCHANTERIC WIRES AFTER TOTAL HIP ARTHROPLASTY
   3. INTRAPERINEAL causes
   3.1 Tumor
   3.2 Hematoma in the psoas muscle
   3.3 Endometriosis
   3.4 Tubo-ovarian abscess
   3.5 Intrauterine device after uterine perforation
   3.6 Anorectal abscess above the levator
   3.7 Aneurysm (abdominal aortic aneurysm)
   4. MR Neurographic techniques commonly used for visualizing sciatic nerve Pathologies.
   5. Case based Pictorial essay with clinical imaging EMNG and Pathological correlation.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jeffrey J. Peterson, MD - 2012 Honored Educator

MK220-ED-TUA10

Imaging Findings of Metabolic Bone Disease Revisited

Station #10

Participants
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TEACHING POINTS

1. Metabolic Bone Disease is a disorder of bone strength, and bone strength arises from two properties: bone mass/mineralization and architecture.
2. Imaging findings of metabolic bone disease are related to the mechanical and micro-anatomic features of bone.

TABLE OF CONTENTS/OUTLINE

1. Overview
2. Osteoporosis
3. Disorders of mineralization: Rickets, Osteomalacia, Hyperparathyroidism, and Renal Osteodystrophy
4. Disorders of bone structure: Paget's disease, Acromegaly, Marrow replacing disorders

MK277-ED-TUA11

Posteromedial Corner Pain: An Important Diagnostic Consideration

Station #11

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TEACHING POINTS

1. Posteromedial corner pain is important but often difficult to diagnose.
2. Imaging findings of Posteromedial Corner Pain can be diagnostic.
TEACHING POINTS

1. To review the anatomy of the posteromedial corner.
2. Review the various pathologic entities affecting the posteromedial corner.
3. To stress the importance of frequently overlooked posteromedial corner injury and how it alters the treatment pathway.

TABLE OF CONTENTS/OUTLINE

1. Review of the functional anatomy of the posteromedial corner
2. Pathophysiology of posteromedial corner injury
3. Specific types of posteromedial corner injuries:
   a. Ligamentous
      i. Posterior Oblique Ligament
   b. Meniscocapsular
      i. Meniscofemoral ligament
      ii. Meniscotibial ligament
   c. Musculotendinous
      i. Semimembranosus insertion fibers
4. Additional pathologic entities in the posterior medial corner causing pain:
   a. Meniscal pathology
   b. Bursitis
5. ACL injury in the setting of concomitant posteromedial corner disruption and how it relates to clinical management
6. Summary


**Musculoskeletal Tuesday Poster Discussions**

Tuesday, Dec. 1 12:45PM - 1:15PM Location: MK Community, Learning Center

**MK**

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

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**Participants**

**Sub-Events**

**MK349-SD-TUB1**  
**Wrisberg Sign: Could be a Marker for High Grade PCL Instability?**  
Station #1

Participants  
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**PURPOSE**  
The purpose of this article is to determine whether wrisberg signs on MRI are a marker for high grade (grade III) posterior cruciate ligament (PCL) instability.

**METHOD AND MATERIALS**  
The study included 30 patients who had a knee injury and underwent both intraoperative posterior drawer test and arthroscopic surgery, between January 2011 to December 2014. All patients underwent 3-T MRI for the diagnosis of PCL injury. If MRI revealed ligament complete disruption (criterion 1) or adding the wrisberg sign to criterion 1 (criterion 2), the injury was considered to be high grade PCL instability. After MRI, knee arthroscopy was performed in all patients for a definitive diagnosis. MRI scans were independently reviewed by two experienced musculoskeletal radiologists (with 13 and 1 years of experience, respectively). Receiver-operating characteristic (ROC) curves were plotted to estimate their diagnostic performance in detecting PCL instability. Interobserver agreement was expressed as unweighted kappa value.

**RESULTS**  
Arthroscopy showed complete disruption of PCL in 29 patients (intraoperative posterior drawer test, grade III) and partial tear of PCL in 1 patient (intraoperative posterior drawer test, grade II). When the MRI diagnosis was based on criterion 1, high grade PCL instability was diagnosed with a sensitivity of 20.7% and an accuracy of 23.3% in both of two readers. When the MRI diagnosis was based on criteria 2, high grade PCL instability was diagnosed with a sensitivity of 73.3% and an accuracy of 72.4% in both readers. By adding wrisberg sign to the criterion 1 (criterion 2), 15 additional patients with high grade PCL instability were diagnosed, most of whom exhibited a complete tear of PCL on arthroscopy and grade III on posterior drawer test. Significantly higher AUC for detecting PCL instability when criterion 2 was added to the diagnosis compared with criterion 1 in both readers (p<.05). The interobserver agreement rate for PCL instability using criterion 1 and criterion 2 were fair and substantial, respectively.

**CONCLUSION**  
Whether partial or complete disruption of PCL on MRI, the morphological feature of wrisberg ligament embedded in the PCL (wrisberg sign) may assist to anticipate the high grade instability of PCL.

**CLINICAL RELEVANCE/APPLICATION**  
Wrisberg sign may be used to evaluate the functional status of PCL deficient knee, thereby potentially assist the treatment decision and subsequently aid in patient care.

**MK350-SD-TUB2**  
**Bone Microarchitecture at the Femoral Attachment Posterior Cruciate Ligament (PCL) by Texture Analysis of Magnetic Resonance Image (MRI) in Patients with PCL Injury: Indirect Reflection of the Ligament Integrity**  
Station #2

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**PURPOSE**  
(1) To evaluate the trabecular pattern of the femoral attachment of posterior cruciate ligament (PCL) on magnetic resonance images (MRI) of patients with a history of PCL injury, (2) to analyze bone microarchitecture at the femoral attachment of PCL by applying gray level co-occurrence matrix (GLCM)-based texture analysis, and (3) to determine if there is significant relation of the bone microarchitecture with posterior instability in patients with PCL tears by comparing the texture values between acute and chronic injury groups.

**METHOD AND MATERIALS**  
Ninety-six patients who have PCL tear and underwent knee MRI were included January 2010 and February 2015, and trabecular
patterns on conventional T2-weighted MRI were evaluated by musculoskeletal radiologist qualitatively and by GLCM-based texture analysis quantitatively. Grades of posterior draw tests and the degrees posterior stress radiographs were recorded. Based on the injury period (6 months) of medical records, the study population was classified into two groups: (1) acute injury and (2) chronic injury with posterior instability. Texture parameters at the PCL femoral attachment were calculated by using ImageJ. The Pearson’s correlation test was used to correlate the degree instability and the texture analysis parameters and the t-test was used to compare the two groups. This protocol was approved by the hospital institutional review board (IRB).

RESULTS
The trabecular pattern at the femoral attachment posterior cruciate ligament (PCL) were apparent thick prominent anisotropic trabeculae in 57 patients of within-normal limit or acute injury (n=37/61; 93.4%) and were not prominent in 31 patients of chronic injury with posterior instability (n=30/35; 85.7%). Grades of posterior draw tests and the degree of posterior stress radiograph were not correlated with texture parameters. However, the texture analysis parameters except entropy were significantly different between the two groups (all are P<0.05).

CONCLUSION
The trabecular pattern and texture analysis parameters are useful to predict posterior instability in patients with PCL injury. The bone microarchitectures resulted from altered biomechanics could be made an advancement in the understanding of PCL function and in the improvement detection of PCL injury.

CLINICAL RELEVANCE/APPLICATION
The trabecular pattern and texture analysis parameters are useful to predict posterior instability in patients with PCL injury.

MK351-SD-TUB3 Qualitative and Quantitative Analyses of Meniscal Tears by Using SWI as Compared with T2 mapping at 3-Tesla MRI

Station #3

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PURPOSE
The purpose of this study was to compare SWI (Susceptibility Weighted Imaging) sequence with T2 mapping sequence in imaging of meniscal tears with qualitative and quantitative analyses at 3T MR.

METHOD AND MATERIALS
Qualitative and quantitative analyses of menisci were performed by using 3T MRI with SWI and T2 mapping techniques on 34 patients who underwent subsequent knee arthroscopy. One hundred and thirty-six sections of meniscus including anterior and posterior horns of medial and lateral meniscus were independently evaluated by two radiologists. The sensitivities, specificities and accuracy of T2 Mapping and SWI for detecting meniscal tears were determined. Statistical significance was determined with McNemar test, Mann-Whitney test, one-way analysis of variance, and Spearman’s rank correlation coefficients.

RESULTS
T2 mapping and SWI had sensitivities of 90% and 87.8%, respectively; specificities of 92.3% and 95.6%, respectively; and accuracy of 91.5% and 93%, respectively for reader 1. For reader 2, T2 mapping and SWI had sensitivities of 84.4% and 87.8%, respectively; specificities of 89% and 92.3%, respectively; and accuracy of 87.5% and 90.8%, respectively. The interobserver agreement had a Cohen κ of 0.97 for T2 mapping and a Cohen of κ 0.89 for SWI, The intraobserver agreements had Cohen κ values respectively; specificities of 95.6% and 92.3%, respectively; and accuracy of 93% and 90%, respectively. The interobserver agreement had a Cohen κ of 0.97 for T2 mapping and a Cohen of κ 0.89 for SWI. The intraobserver agreements had Cohen κ values of 0.85 and 0.82 for T2 mapping, 0.89 and 0.82 for SWI, respectively. There was no significant difference in detection of meniscal tears on T2 mapping compared with SWI for both readers. There were significantly differences between torn and torn meniscus of phase value and T2 value (P<0.05). Both phase value and T2 value demonstrated a greater ability to distinguish normal and meniscal tear using receiver operating characteristic (ROC) analysis. The areas under the ROC curves for reader 1 and reader 2 were respectively 0.95 and 0.88, which were significantly different. Significant negative correlations between phase value and arthroscopy(R=0.77, P<0.01), as well as T2 value and arthroscopy(R=0.64, P<0.01) were observed.

CONCLUSION
T2 mapping and SWI are reliable and accurate for detection of meniscal tears. Meniscal phase values and T2 values correlate with arthroscopy of meniscus and can be used to differentiate healthy subjects from patients with meniscal tear.

CLINICAL RELEVANCE/APPLICATION
Our study results indicate high accuracy for T2 mapping and SWI in the diagnosis of meniscal tears.

MK352-SD-TUB4 Shear-Wave Ultrasound Elastography Evaluation of the Supraspinatus Tendon

Station #4

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Purpose
The purpose of this study was to compare the two groups. This protocol was approved by the hospital institutional review board (IRB).
PURPOSE
To demonstrate that the sonographic morphology of the supraspinatus tendon correlates with elasticity.

METHOD AND MATERIALS
This retrospective study included 36 patients who underwent sonographic evaluation of one or both shoulders on one or multiple dates from June 2013 through October 2014. A shoulder was excluded if the supraspinatus tendon contained calcifications or was postsurgical. Each sonographic evaluation of each shoulder was regarded as a separate data point. The morphology of the proximal and distal supraspinatus tendon was graded (1 = normal or mild tendinosis without a tear, 2 = moderate or severe tendinosis without a tear, 3 = partial tear, 4 = full-thickness tear), and sample volumes were placed randomly within the tendon, viewed in the longitudinal axis, to obtain shear wave velocities. Sample volumes also were placed randomly within the deltoid muscle to obtain shear wave velocities. Spearman rank correlations assessed the association between morphology grade and shear wave velocities. Mann-Whitney tests compared shear wave velocities between scans grouped by symptoms or morphology grade. Bootstrap resampling procedures accounted for lack of statistical independence among scans of the same patient.

RESULTS
The morphology grade and shear wave velocities were correlated in both the proximal (p < 0.001) and distal (p = 0.002) tendon. Comparing between grade 1 and ≥ 2 morphology, shear wave velocities differed significantly in both the proximal (p = 0.001) and distal (p = 0.012) tendon. Comparing between grade ≤ 2 and > 2 morphology, shear wave velocities also differed significantly in both the proximal (p = 0.002) and distal (p = 0.004) tendon. Interestingly, deltoid muscle shear wave velocities also were associated with the morphology grade of the proximal (p = 0.004) and distal (p = 0.007) supraspinatus tendon; this measurement also differed significantly based on symptoms (p = 0.001).

CONCLUSION
The sonographic morphology of the supraspinatus tendon correlates with mechanical properties, as assessed by shear-wave ultrasound elastography. Correlation of deltoid muscle elasticity with supraspinatus tendon morphology and symptoms may be related to the two muscles being a force couple. Further research should correlate elasticity with intraoperative evaluation of tendon quality.

CLINICAL RELEVANCE/APPLICATION
Shear-wave ultrasound elastography can provide a preoperative objective evaluation of tendon elasticity.

MK353-SD-TUB5
X-ray Temporal Subtraction Analysis of Finger Joint Space Narrowing with Ultrasonographic Synovitis in Rheumatoid Patients with Long-term Sustained Clinical Low Disease Activity

Participants
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PURPOSE
It is recognized that finger joints with positive synovial vascularity (SV) under clinical low disease activity (CLDA) may cause structural deterioration in rheumatoid arthritis (RA). The purpose of this study is to validate the computer-based quantification of joint space width difference using temporal subtraction which can detect interval joint space narrowing (JSN) change between two radiographical finger images as joint space difference index (JSDI).

METHOD AND MATERIALS
The study consisted of 15 RA patients (13 female, 2 male) with long-term sustained CLDA of > 2 years (minimum of 1 year of CLDA for study entry plus 1 year of observation). Radiological progression of metacarpo-phalangeal (MP) and proximal interphalangeal (PIP) joints was evaluated using JSDI as well as according to the Genant-modified Sharp score (GSS) (0-52 weeks). We also quantitatively assessed SV of these joints using ultrasonography. We then compared the detection ability in interval JSN change between JSDI and GSS.

RESULTS
The JSDI of the RA patients was significantly different between joints with and without JSN progression for MP/PIP joints (Mann-Whitney U test, p < 0.001). There was no statistically significant difference in the JSDI between left and right MP/PIP joints (Mann-Whitney U test, p = 0.14). The JSDI of MP/PIP joints with positive SV was significantly higher than those with negative SV (Mann-Whitney U test, p = 0.01).

CONCLUSION
The computer-based quantification of joint space using temporal subtraction can recognize the interval difference in MP/PIP joint space on radiographs objectively.

CLINICAL RELEVANCE/APPLICATION
The computer-based quantification of joint space width difference using temporal subtraction can objectively detect slight JSN changes on radiographs in clinically inactive rheumatoid patients.

MK354-SD-TUB6
Titanium Fixation Devices do not Influence T2 Relaxation Times of Knee Articular Cartilage after High Tibial Osteotomy: A Human Cadaver Study

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PURPOSE
High tibial osteotomy (HTO) is an effective therapy to delay joint replacement in patients with early stage knee osteoarthritis. Quantitative biochemical MRI techniques are increasingly used in osteoarthritis research to study therapeutic effects on cartilage composition and to accurately compare different treatment strategies. An important challenge for the application of these techniques in the context of HTO is the presence of metal fixation devices after the procedure. The actual osteotomy was not performed. Mean T2 relaxation times were calculated in 6 cartilage regions (located in the medial and lateral weight-bearing and posterior cartilage of the femoral condyles and tibial plateau). Corresponding slices with and without fixation devices were carefully defined by an experienced researcher. T2 relaxation times before and after implantation of the metal fixation devices were compared with paired t-tests.

RESULTS
T2 relaxation times before and after implantation of metal fixation did not significantly differ. Mean T2 relaxation values for the different regions were: femur posterior lateral 50.5 vs. 52.7 ms (p=0.23); femur posterior medial 57.8 vs. 59.5 ms (p=0.41); femur weight-bearing lateral 61.1 vs. 58.7 ms (p=0.30); femur weight-bearing medial 58.4 vs. 56.3 ms (p=0.54); tibia weight-bearing lateral 62.6 vs. 58.9 ms (p=0.07); tibia weight-bearing medial 58.0 vs. 54.0 ms (p=0.13).

CONCLUSION
Based on the current data we found no evidence to suggest that titanium fixation devices used in high tibial osteotomy influence T2 relaxation times.

CLINICAL RELEVANCE/APPLICATION
Despite the presence of a titanium fixation device, our results suggest that it is still possible to perform T2 mapping of cartilage composition after high tibial osteotomy.

MK355-S0-TUB7 The Correlation of vBMD Measured by Quantitative CT and Bone Strength and Its Clinical Value on Osteoporosis Patients

Station # 7

Participants
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PURPOSE
Areal bone mineral density (aBMD) measured by dual-energy X-ray absorptiometry (DXA) has been widely used to assess the fracture risk in clinical examination. However, the correlation between aBMD and bone strength is relatively weak. Quantitative computed tomography (QCT) is a new method to measure volumetric bone mineral density (vBMD). In this study, we aimed to assess the correlation between vBMD and bone strength, and to find out that if vBMD could better reflect the real bone strength. aBMD and vBMD values of vertebral compression fractures patients were also measured, to evaluate the detection rate of osteoporosis by QCT and DXA.

METHOD AND MATERIALS
Ex vivo studies were performed with T12-L5 vertebral bodies from 6 cadavers. All the specimens were examined with DXA and QCT to acquire aBMD and vBMD. Axial compression tests were performed on the specimens to obtain the biomechanical parameters: ultimate stress and yield stress. Pearson’s correlation analyses were performed between aBMD and vBMD, aBMD and biomechanical parameters, vBMD and biomechanical parameters. In addition, 70 volunteers with vertebral compression fractures were scanned by QCT and DXA to obtain aBMD and vBMD.

RESULTS
1. Coefficient of correlation between aBMD and vBMD was 0.893. Coefficients of correlation between aBMD and biomechanical parameters were 0.521 for ultimate stress, 0.497 for yield stress. Coefficients of correlation between vBMD and biomechanical parameters were 0.759 for ultimate stress, 0.811 for yield stress. The correlation between vBMD and biomechanical parameters was better than that between aBMD and biomechanical parameters. 2. In 70 vertebral compression fractures cases, the osteoporosis detection rate by DXA was 85% while QCT was 95%, significantly higher than that of DXA.

CONCLUSION
Our results demonstrated that vBMD measured with QCT correlated well with bone strength, and vBMD could reflect the bone
Open the Windows: The Diagnostic Value of Soft Tissue Window Settings in Musculoskeletal CT

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TEACHING POINTS
1. Discuss technical considerations for improving visualization of soft tissue structures on CT including slice thickness, reconstruction algorithms, and knowledge-based iterative reconstruction models as well as volume and surface rendering
2. Demonstrate utility of soft tissue window setting in maximizing fracture detection in osteopenic patients as well as aiding in the comprehensive evaluation of musculoskeletal trauma
3. Depict the bone marrow findings in osteomyelitis and bone tumors which can precede bone involvement
4. Illustrate the importance of soft tissue window evaluation in the detection of significant incidental findings

TABLE OF CONTENTS/OUTLINE
1. Technical considerations to optimize soft tissue structure visualization on CT Reconstruction algorithm Slice thickness Knowledge-based iterative reconstruction Volume and surface rendering
2. Utility of soft tissue window setting in evaluation of trauma Optimizing fracture detection in osteopenic patients Comprehensive evaluation of musculoskeletal trauma Soft tissue injury and entrapment (tendons, cartilage, vascular)
3. Bone Marrow Evaluation on CT Osteomyelitis Malignancy Significant incidental findings on MSK CT

Nontraumatic Palpable Lesions Related to Tendon Sheath in Hands and Feet: Imaging Findings

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Jon A. Jacobson, MD, Ann Arbor, MI (Abstract Co-Author) Consultant, BioClinica, Inc; Royalties, Reed Elsevier;
Corrie M. Yablon, MD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
After reviewing this exhibit, the learner will be able to:
1. List differential diagnoses of nontraumatic palpable lesions of the tendon sheath in hands and feet
2. Know about the characteristic imaging findings to suggest specific diseases of tendon sheath

TABLE OF CONTENTS/OUTLINE
1. Plain radiography, ultrasonography, CT, and MRI will be included in imaging modalities of this exhibit. Differential diagnoses of nontraumatic palpable lesions of tendon sheath: Giant cell tumor of tendon sheath Fibroma of tendon sheath Fibromyxoma Synovial chondromatosis of tendon sheath Ganglion Nodular hyperplastic synovium with fibrosis Tenosynovitis

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jon A. Jacobson, MD - 2012 Honored Educator

Appreciating MoM: Demystifying the Complications of Metal-on-metal Hip Articulations

Participants
Phey M. Yeap, MBCHB, FRCR, Dundee, United Kingdom (Presenter) Nothing to Disclose
Jonathan Weir-McCall, MBCHB, FRCR, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
Matthew J. Budak, MD, FRCR, Edmonton, AB (Abstract Co-Author) Nothing to Disclose
Thiru A. Sudarshan, DMRD, FRCR, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
Ian A. Zealley, MD, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
David Scott, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Metal-on-metal (MoM) total hip arthroplasty and resurfacing is an alternative to traditional total hip replacement as it allows greater range of movement and has low dislocation rate. However it has been linked with serious complications and has consequently become the subject of controversy. Imaging plays a critical role in detecting many of these complications. The aims of this exhibit are:
1. Review complications related to MoM hip prostheses
2. Illustrate key imaging findings associated with MoM

vBMD measured by QCT correlates better with bone strength than aBMD measured by DXA. QCT is a prospective method to assess the osteoporotic fracture risk in clinical examination.
complications through example cases. Discuss the utility and respective limitations of various imaging modalities when assessing for MoM complications.

**TABLE OF CONTENTS/OUTLINE**

Introduction to MoM - history - potential advantages - clinical indications  
Complications of MoM with examples - aseptic lymphocyte-dominant vasculitis associated lesion (ALVAL)/ pseudotumour - fluid collection/bursal cyst - osteolysis - heterotropic ossification - aseptic loosening - fracture - damage to tendons and nerves/ muscle atrophy  
Optimal imaging strategies including the role of radiography - computed tomography - magnetic resonance imaging  

**MK280-ED-TUB11**  
**Ankle Trip: A Guided Tour of Common and Uncommon Trauma Findings on Radiographs**  
Station #11

**Participants**  
Pavani Thotakura, MD, Winston Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
Bahram Kiani, MD, Winston Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
Maha Torabi, MD, Winston Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
Leon Lenchik, MD, Winston Salem, NC (*Abstract Co-Author*) Nothing to Disclose  
Scott D. Wuertzer, MD, MS, Winston-Salem, NC (*Presenter*) Nothing to Disclose

**TEACHING POINTS**

1. Provide a search pattern, a "map", for ankle radiographs to improve image interpretation for junior residents.  
2. Illustrate the value of this search pattern through commonly missed injuries.

**TABLE OF CONTENTS/OUTLINE**

1. Background  
2. AP View - anatomy, pathology, and case examples  
   1. Soft tissues over the malleoli  
   2. Origin of extensor digitorum brevis  
   3. Lateral process of talus  
   4. Tip of fibula  
   5. Mid to distal fibula  
   6. Tibiofibular clear space  
   7. Medial malleolus  
   8. Tibial plafond  
3. Mortise View - anatomy, pathology, and case examples  
   1. Soft tissues over the malleoli  
   2. Origin of extensor digitorum brevis  
   3. Lateral process of talus  
   4. Tip of fibula  
   5. Mid to distal fibula  
   6. Tibiofibular clear space  
   7. Medial malleolus  
   8. Tibial plafond  
4. Lateral View - anatomy, pathology, and case examples  
   1. Anterior tibiotalar joint for an effusion  
   2. Dorsal talar and navicular bones  
   3. Base of the 5th metatarsal  
   4. Anterior process of the calcaneus  
5. Summary
**MSES33**

**Essentials of Musculoskeletal Imaging**

Tuesday, Dec. 1 1:30PM - 3:00PM Location: S100AB

MK MR US

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

**Participants**

**Sub-Events**

**MSES33A** Introduction to Musculoskeletal Ultrasound

Participants
Maha Torabi, MD, Winston Salem, NC, (mtorabi@wakehealth.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) List the indications, benefits, and limitations of musculoskeletal ultrasound. 2) Demonstrate proper transducer manipulation and system optimization to produce diagnostic images. 3) Recognize common pathology of the musculoskeletal system as seen at ultrasound.

**ABSTRACT**

**MSES33B** MRI of Injuries in the High Performance Athlete

Participants

**LEARNING OBJECTIVES**

1) Recognize patterns of injury in high performance athletes using MRI. 2) Be able to relate pathology to common injuries in the general population. 3) Realize implications of injury in females and adolescent athletes.

**MSES33C** Return to Play: Imaging the Athlete

Participants
Bethany U. Casagranda, DO, Pittsburgh, PA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Define Return to Play. 2) Discuss social pressures and controversial dogma surrounding Return to Play. 3) Recognize imaging findings of common sports related injuries. 4) Discuss the radiologist’s role in diagnosis of pathology and communication with referring physicians.

**ABSTRACT**

Athletes of all levels are encumbered by injury and the social stresses of returning to play (RTP). RTP is a broad topic describing the time it takes an athlete to return to their sport after sustaining an injury. This discussion will encompass various levels of play, several sports and position-specific injuries. The focus will be on common injuries as well as controversial topics. Overall, emphasis is on imaging and the role of the radiologist caring for athletes.
Participants
Matthew R. Callstrom, MD, PhD, Rochester, MN (Moderator) Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Gall Medical Ltd

Sub-Events

**VSIO31-01 How to Approach Lung Ablation**

Participants
Constantinos T. Sofocleous, MD, PhD, New York, NY (Presenter) Consultant, Sirtex Medical Ltd

**LEARNING OBJECTIVES**

1) Review role of SBRT in the primary management of early stage NSCLC. 2) Review updates to the literature on SBRT including: a. Dose and schedule of SBRT. b. Comparison of SBRT to surgery.

**ABSTRACT**

Stereotactic Body Radiotherapy (SBRT) is an important treatment modality for patients with inoperable Non-Small Cell Lung Cancer. It provides effective local control of early stage Lung Cancers and is associated with minimal toxicity. In this presentation I will review this role and discuss the current literature comparing SBRT to observation and surgery.

**VSIO31-02 Role for SBRT in the Treatment of Primary Lung Tumors**

Participants
Kenneth R. Olivier, MD, Rochester, MN (Presenter) Nothing to Disclose

**PURPOSE**

To evaluate the association between mutation status of lung adenocarcinoma patients and local recurrence after ablation.

**METHOD AND MATERIALS**

We performed a retrospective review to identify patients treated with ablation for lung adenocarcinoma and that had available genetic testing for both EGFR and KRAS mutations. Surgical or biopsy specimens were considered only if they were from the same site as the ablation (either pre- or post-ablation). A subset of the EGFR mutants were also tested for T790M mutation. Local recurrence was either biopsy proven or based on a combination of clinical and imaging parameters. Chi-square test was used to identify statistically significant association with local recurrence.

**RESULTS**

We identified a total of 53 lung adenocarcinomas treated with lung ablation and which had genetic testing to identify both EGFR and KRAS mutations. Overall stage of tumor ranged from stage 1A to stage IV. Median tumor size was 1.6 cm (range: 0.8-3.3 cm). Of the 53 lung ablations, 53% (28) were on wild type (WT) lung adenocarcinomas, 34% (18) were on KRAS mutants and 13% (7) were on EGFR mutants. EGFR and KRAS mutants were mutually exclusive. Local recurrence rates were 29% (8/28) for WT, 67% (12/18) for KRAS, and 29% (2/7) for EGFR mutants. Local recurrence in the KRAS group was statistically significant (p=0.01) compared with WT. There was no difference in the local recurrence rate of EGFR mutants compared with WT. Of note, the two local recurrences identified in the EGFR group also harbored a T790M mutation, associated with acquired resistance to tyrosine kinase inhibitors.

**CONCLUSION**

KRAS mutations are associated with statistically significant increased risk of local recurrence compared to WT. The local recurrence
LEARNING OBJECTIVES

1) Define the role of surgical pulmonary metastasectomy. 2) Review the literature regarding surgical pulmonary metastasectomy. 3) Review advantages to minimally invasive surgical pulmonary metastasectomy. 4) Define future goals of a novel approach to combined multi-specialty approach to lung metastasectomy.

ABSTRACT

Care of the patient with pulmonary metastases (PM) has evolved through the years to now include a larger group of patients who may benefit from metastasectomy. The two most consistent prognostic factors for overall survival remain disease free interval (DFI) and number of pulmonary nodules. The one consistent factor in all series is that only patients achieving a complete (R0) resection have a longer survival. Many series find the # of nodules is no longer a factor determining survival if R0 resection can be obtained, even repeated metastasectomy. We no longer view extra-PM as a disqualifier for resection, as long as the dz can be completely resected and controlled. Patients are typically referred for immediate surgery if they present with a single PM or have a limited # of mets and a long DFI. Those who develop metastatic dz early are treated initially with chemotherapy to determine the pace of dz progression, if any, on treatment. Patients responding to chemotherapy, those with stable dz, and those with slow progression are referred for resection while those with rapidly progressive metastatic dz receive alternative chemotherapy treatment. Adjuvant chemotherapy is continued only if there is evidence of clinical benefit from preoperative chemotherapy. CT scanning is routinely performed to monitor dz progression. The surgical approach should be individualized. As imaging improves our ability to localize smaller nodules, less invasive options become more appealing and may facilitate less difficult repeat metastasectomy. Ablation (SABR/SBRT or lung CT-guided ablation by cryoablation, radiofrequency ablation or microwave ablation) has been used to treat patients with PM, and our institution uses a lung ablation tumor board to review which lesions are best treated with each modality, focusing on R0 treatment, lung preservation, and location of the tumor. Lung preservation achieved by ablation is important in patients who have had previous resections or who have compromised pulmonary function or in whom a lobectomy would be required for nodule removal. More prospective studies are needed and are underway. Better understanding of the biology of the tumor and more developed histologic-specific nomograms may ultimately improve our ability to better select patients. As systemic therapy improves, treatment of local residual oligometastatic dz will become an increasingly important consideration.

VSIO31-05 Percutaneous Ablation of Lung Metastases

Tuesday, Dec. 1 2:40PM - 3:00PM Location: S405AB

Participants
Alison R. Gillams, MBChB, London, United Kingdom. (alliesorting@gmail.com) (Presenter) Advisory Board, Covidien AG

LEARNING OBJECTIVES

1) To define the patients most suitable for percutaneous image guided ablation of their metastases. 2) To present clinical outcomes of percutaneous ablation in the common metastatic groups - colorectal, sarcoma, renal, head and neck etc. 3) To understand the role of ablation in conjunction with other therapeutic modalities - surgery, SBRT or chemotherapy.

ABSTRACT

Ablation is a very effective tool for the local control of small volume lung tumours. It is the optimal technique for bilateral or small volume but multifocal disease. Although any metastatic deposit can be treated, the most common tumour groups to be referred for ablation are colorectal, sarcoma, head and neck and renal tumours. Colorectal metastases form the largest single cohort of patients. Results from recent metaanalysis suggest a survival advantage. Number, distribution and speed of development i.e. disease free interval between primary resection and the development of lung metastases, are considered when deciding whether a patient is operable. Surgical preference is given to fit patients with fewer than 3 metachronous metastases, preferably unilateral, a longer disease free interval and no extra-pulmonic disease. Ablation is currently considered in inoperable patients. Our analysis of 122 patients who were not operable candidates but who had small volume colorectal lung metastases showed a median survival of 41 months and a 3-year survival of 57%. Survival was better in patients with smaller tumours; median 51 months, 3-year 64% for

VSIO31-06 Complications and Management after Lung Ablation

Tuesday, Dec. 1 3:00PM - 3:20PM Location: S405AB

Participants
Damian E. Dupuy, MD, Providence, RI. (ddupuy@lifespan.org) (Presenter) Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

LEARNING OBJECTIVES

1) Understand the most common adverse events related to lung ablation. 2) Learn how to prevent and treat some of these adverse events. 3) Illustrate some of the more severe adverse events (grade 3-5) with clinical examples.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying
Morphological Appearance of Radiofrequency Ablated Stage I NSCLC in Medically Inoperable Patients as Related to Recurrence: Results from the ACOSOG Z4033 (Alliance Trial)

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S405AB

Participants
Lillian Xiong, MD, Providence, RI (Presenter) Nothing to Disclose
Erica S. Alexander, BS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Shauna Hillman, MS, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Angelina D. Tan, BS,BA, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Grayson L. Baird, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Hiran Fernando, MD, Boston, MA (Abstract Co-Author) Consultant, CSA Medical, Inc Research Consultant, Galil Medical Ltd Research Grant, Deep Breeze Ltd
Damian E. Dupuy, MD, Providence, RI (Abstract Co-Author) Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

PURPOSE
This study evaluates tumor and ablation zone morphology as related to recurrence in medically inoperable patients with stage I NSCLC undergoing CT-guided RFA in a prospective multi-center trial.

METHOD AND MATERIALS
This prospective, multicenter group trial was approved by each institutional review board. 54 patients from 16 US sites were enrolled, of these, 50 patients (23 Men, 27 Women; mean age 75.3±7.5 years) met eligibility requirements. Patients were followed using CT; evidence of CT recurrence and pre- and post-ablation imaging characteristics were recorded. Characteristics evaluated included tumor/ablation zone shape (round, ovoid, bilobed, irregular), size, borders (smooth, speculated, lobulated), distance to large vessels/airway and distance to pleura.

RESULTS
A difference was observed for months to recurrence between those with ablation zones greater than 3cm and less than 3cm (p=.0023). The median time of recurrence for those with ablation zones less than 3cm was 8.16 months, while the median recurrence time for those with zones greater than 3cm could not be determined. Recurrence free probability was 30% for those with ablation zones less than 3cm and 75% for those with zones greater than 3cm.No significant differences were found between those with and without recurrence for age (p=.47), performance score (p=.43), histology (p=.34), baseline tumor SUV (p=.91), tumor size (p=.59), peak power (p=.92), peak current (p=.63), max temp (p=.65), total time (p=.28), shape (p=.30), cavitation (p=.29), sphericity (p=.45), distance from tumor edge to large vessel (p=.62), and distance to pleura (p=.25).

CONCLUSION
Of those morphological characteristics considered, size of ablation zone appears to be most predictive of recurrence-free survival for those patients treated with RFA for early stage lung cancers.

CLINICAL RELEVANCE/APPLICATION
Post-radiofrequency ablation zones greater than 3-cm were significantly less likely to be associated with recurrent disease, in a multi-institutional prospective study of 50 stage I NSCLC patients.
Bone fractures can result in significant pain and loss of function in cancer patients. Percutaneous screw fixation is a very new technique that consists in the insertion of screws in bone structures through a very small skin incision under imaging guidance. The indications are twofold for bone fracture: palliative and preventive. 1/ For patients suffering from pathological or non-pathological fracture the goal of the screw fixation is to achieve a stabilization of the fracture fragments that will result in pain palliation. Typically, the fractures that can be fixed are located in the sacrum, the iliac crest, the acetabulum roof, the pubic ramus and the proximal femur. Cementoplasty can be performed in association (augmented screw fixation) in order to improve the screw's tip anchorage. 2/ For patients with impending osteolytic metastases, the decision to perform percutaneous augmented screw fixation instead of cementoplasty alone is done by the fact the strength properties of the cement are strong in compression but weak for tensile or shear stresses. Typically, the impending osteolytic metastases that can be consolidate using percutaneous augmented screw fixation are located in the iliac crest, the acetabulum and in the proximal femur. Percutaneous screw fixation is a very effective tool that must be considered as a part of the therapeutic arsenal of the interventional radiologists. Firstly, because it is a minimally invasive procedure that avoids extensive surgical exposure and secondly because the accuracy provided by CT- or Flat panel- guidances results in high technical success and very low complication rate for the screw placement.

VSIO31-10 Patient Selection and Outcomes with MRgFUS

Tuesday, Dec. 1 4:20PM - 4:40PM Location: S405AB

Participants
Alessandro Napoli, MD, Rome, Italy, (alessandro.napoli@uniroma1.it) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To become familiar with the basic principles of HIFU and the potential of MR guidance. 2) To approach selection criteria in MRI screening examinations for accurate indications and identify contraindications and non-suitable patients. 3) To appreciate current results and potential therapy regimens. 4) To understand recent technical developments and their potential.

ABSTRACT

Bone metastases are common in patients with advanced cancer and are the greatest contributor to cancer-related pain, often severely affecting quality of life. Many patients with advanced cancer are undertreated for pain. Radiation therapy (RT), together with systemic therapies and analgesics, is the standard of care for localized metastatic bone pain, although up to two-thirds of patients have residual pain after RT, leaving them with limited treatment options. These include reirradiation, which results in temporary pain reduction in some patients, surgical intervention, and percutaneous cryoablation. More effective systemic therapies are prolonging survival of cancer patients with metastatic disease, resulting in an increased need for alternative therapies for painful bone metastases. Focused ultrasound is a noninvasive technique that delivers acoustic energy to heat lesions focally to ablative temperatures of more than 65°C. The combination of focused ultrasound with magnetic resonance (MR) imaging enables physicians to perform precise localized tumor tissue ablation, while using MR thermometry for real-time temperature monitoring. Clinical studies on the use of MR-guided focused ultrasound surgery (MRgFUS) for palliation of painful bone metastases demonstrated excellent response rates and safety. Results of a randomized controlled trial will be reviewed to discuss safety and efficacy of MRgFUS for treating bone metastases in patients with persistent or recurrent pain after RT, or who were otherwise not candidates for RT, or who declined RT. MRgFUS has several advantages that may positively influence safety and effectiveness compared with other ablative therapies. These include high-resolution imaging of the targeted tumor and nontargeted normal anatomy, intraintrusional MR thermometry accurate within approximately 2° to verify adequate temperatures to achieve ablation while respecting normal tissue tolerances, and immediate post-treatment validation of the extent of ablation.

VSIO31-11 Minimally Invasive Treatment of Osteoid Osteoma: Experience of a Single Center Using MR Guided Focused Ultrasound Surgery (MRgFUS) or Radiofrequency Ablation (RFA)

Tuesday, Dec. 1 4:40PM - 4:50PM Location: S405AB

Participants
Francesco Arrigoni, Coppito, Italy (Presenter) Nothing to Disclose
Alice La Marra, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Mariani, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate effectiveness and safety of minimally invasive treatment of Osteoid Osteoma (OO) with ablation techniques: Magnetic Resonance guided Focused Ultrasound Surgery (MRgFUS) and Radiofrequency Ablation (RFA).

METHOD AND MATERIALS

From March 2011 to March 2014 we treated 40 OO, 18 with MRgFUS (ExAblate InSightech, Israel) and 22 with RFA (Needle Electrode, Boston Scientific-USA). For each patient we chose the less invasive treatment, when applicable. When the lesion could be easily reached with the US beam, the patient was treated with MRgFUS; otherwise, the patient was treated with RFA. Sixteen OO were treated with MRgFUS in the lower arm and 2 in the upper. The treatments lasted a mean time of 110 minutes. The lesions treated with RFA were 18 in the lower extremities, 2 in the upper ones and 2 in the vertebral body. They were treated in less than 100 min. The follow-up was performed by MRI and CT up to a maximum of two years; the clinical evaluation was performed using the visual analogue scale (VAS).

RESULTS

All patients, except one treated with MRgFUS and subsequently re-treated with RFA, showed a regression of painful symptomatology. After treatment, they no longer needed any pain medication. The mean hospitalization time was 2 days for patients treated with MRgFUS and 2.4 days for those submitted to RFA. The mean VAS value, 2 years after treatment, showed an overall improvement of 100% (from 8.2 to 0). At the first control at one week after the procedure, patients treated with MRgFUS showed a lower mean VAS value (0.5) as compared with that of RFA (0.8). The results of MRI and CT, 2 years after the treatment, showed in all cases the disappearance of both bone edema (MRI) and nidus with central calcification and peripheral osteosclerosis (CT), that are typical findings of the osteoid osteoma. In no case, major complications were observed.
CONCLUSION

Though based on a limited group of patients, our study demonstrates the safety and effectiveness of both techniques in the treatment of OO, by which it was possible to obtain an optimal clinical and imaging outcome. Compared with RFA, MRgFUS is less invasive, but to be successful, it is mandatory that the US beams properly reach the region of interest.

CLINICAL RELEVANCE/APPLICATION

To evaluate safety and efficacy of an innovative technique of ablation, MRgFUS, which promises to be even less invasive than RFA, which is currently the gold standard in the treatment of OO.

VS1O31-12 Spine Metastases Palliation-Ablation Stabilization

Tuesday, Dec. 1 4:50PM - 5:10PM Location: S405AB

Participants
Jonathan M. Morris, MD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1. Learn the basics of ablative technologies available for use in the spine and sacrum. 2. Define current indications for percutaneous ablation in the Spine and Sacrum. 3. How we do it. Lessons learned and resources needed. 4. Define local control rates for the varied tumors treated. 5. Discuss our experience with palliative outcomes for pain relief. 6. Limitations of ablation in the neuroaxis. 7. Postablative kyphoplasty/vertebroplasty. 8. Discuss unique considerations for cervical, thoracic, lumbar spine and sacrum.

ABSTRACT

Oligometastatic disease involving the spine and sacrum is growing due to an aging population as well as improved survival rates of varied primary malignancies. 70% of all cancer patients will have metastatic disease with 40% involvement of the neuroaxis and 20% with epidural disease. While radiation therapy continues to be the primary treatment a subset of tumors are not radiosensitive and of those which are there are non responders. Starting in 2009 this clinical need led us to develop an ablation service dedicated to the spine and sacrum to aid in the treatment of oligometastatic disease. This talk will enable the attendee to learn the basics of ablative technologies in the spine and sacrum. Learn current indications for this technologies. Learn "how we do it“ including lessons learned and resources need to perform this type of treatment. We will discuss the role of post ablative kypholplasty/vertebroplasty. Finally we will review our palliative pain relief results as well as local control rates in the increasing types of tumors treated.

VS1O31-13 Ablation is Front-line Therapy for Desmoid Tumors

Tuesday, Dec. 1 5:10PM - 5:30PM Location: S405AB

Participants
Afshin Gangi, MD, PhD, Strasbourg, France (Presenter) Nothing to Disclose

VS1O31-14 CT-guided Cryoablation as Single Treatment or Combined with Radiotherapy in the Management of Bone and Soft Tissue Lesions

Tuesday, Dec. 1 5:30PM - 5:40PM Location: S405AB

Participants
Francesco Arrigoni, Coppito, Italy (Presenter) Nothing to Disclose
Silvia Mariani, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Alice La Marra, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate safety and efficacy of percutaneous CT-guided cryoablation, performed with multiple cryoprobes (also in combination with Radiotherapy) in the treatment of bone and soft tissue lesions.

METHOD AND MATERIALS

Up to April 2015, we treated 27 patients with percutaneous CT-guided cryoablation. All patients but one had osteolytic bone metastases; one patient had a recurrence of aggressive fibromatosis of the shoulder. Prior to treatment, the patients were evaluated with the VAS questionnaire for pain which resulted in a mean value of 7.6. For a faster and more comfortable procedure, we employed three to six cryoprobes for each lesion under fluoroscopic guide. The area of cryoablation (iceball) and the position of the cryoprobes were controlled during the procedure with a wide-volume acquisition, employing 3D and MPR reconstruction. Follow-up studies at 3 and 6 months were performed with CT and VAS questionnaire. No major complications occurred during the procedures.

RESULTS

We observed a reduction of pain in all patients. The mean VAS value dropped from 7.6 to 1.6 one week after treatment and remained substantially unchanged until the end of follow-up (6 months). CT follow-up showed progression of the disease in no case. Only size reduction or stationary CT findings were observed.

CONCLUSION

Our results show the effectiveness of cryoablation, particularly in combination with RT, in terms of tumoral mass control and particularly of pain relief. Through thermoablation in fact it is possible to obtain a prompt relief of pain, and enhancement of the quality of life immediately after the treatment. The main advantages are the possibility to treat the whole lesion at the same time with the use of multiple cryoprobes and to check in real time the treated volume; the main limitations are represented by the low number of patients recruited and by the length of the follow-up.
CLINICAL RELEVANCE/APPLICATION

To evaluate safety and effectiveness of cryoablation also in combination with RT in the management of painful bone and soft tissue lesions, with the aim of reducing tumoral mass and pain.

VSIO31-15  Bone Metastases Tumor Board

Tuesday, Dec. 1 5:40PM - 6:00PM Location: S405AB

Participants
Matthew R. Callstrom, MD, PhD, Rochester, MN (Moderator) Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd
Muscle-Tendon-Enthesal Unit: Form, Function, and Dysfunction with Emphasis on MR

Tuesday, Dec. 1 4:30PM - 6:00PM Location: E451B

Participants
Donald L. Resnick, MD, San Diego, CA (Director) Nothing to Disclose
Donald L. Resnick, MD, San Diego, CA (Presenter) Nothing to Disclose
Mini N. Pathria, MD, San Diego, CA (Presenter) Nothing to Disclose
Christine B. Chung, MD, San Diego, CA (Presenter) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how variations in the macroscopic architecture of muscle relate to its physiological function, affect its risk of injury, and determine the pathoanatomy and imaging appearance following muscle strain. 2) Understand anatomy and histology of tendon, its normal and abnormal imaging appearances, and common patterns of tendon pathology based on anatomic location. 3) Review the anatomy of the tendon-entheseal unit with emphasis on the types of lesion that affect the region of the footprint, with emphasis on MR imaging.
Nerve Ultrasound Based on a Regional Approach: Elbow to Hand (Hands-on)

Tuesday, Dec. 1 4:30PM - 6:00PM Location: E264

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Carlo Martinoli, MD, Genova, Italy, (carlo.martinoli@unige.it) (Moderator) Nothing to Disclose
J. Antonio Bouffard, MD, Detroit, MI (Presenter) Nothing to Disclose
Catherine J. Brandon, MD, Ann Arbor, MI (Presenter) Stock options, VuCOMP, Inc
Mary M. Chiavaras, MD, PhD, Ancaster, ON (Presenter) Nothing to Disclose
Joseph G. Craig, MD, Detroit, MI (Presenter) Nothing to Disclose
Michael A. DiPietro, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
David P. Fessell, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Ghiyath Habra, MD, Royal oak, MI (Presenter) Nothing to Disclose
Marnix T. van Holsbeeck, MD, Detroit, MI, (marnix@rad.hfh.edu) (Presenter) Consultant, General Electric Company Consultant, Koninklijke Philips NV Stockholder, Koninklijke Philips NV Stockholder, General Electric Company Grant, Siemens AG Grant, General Electric Company
Rachel B. Hulen, MD, Novi, MI (Presenter) Nothing to Disclose
Marina Kislakova, MD, Moscow, Russia, (m.kislakova@yandex.ru) (Presenter) Nothing to Disclose
Joseph H. Intorcado, MD, Neenah, WI (Presenter) Nothing to Disclose
Jon A. Jacobson, MD, Ann Arbor, MI (Presenter) Consultant, BioClinica, Inc; Royalties, Reed Elsevier;
Kenneth S. Lee, MD, Madison, WI (Research Consultant, SuperSonic Imagine; Consultant, Echometrix, LLC; Royalties, Reed Elsevier
Humberto G. Rosas, MD, Madison, WI (Presenter) Nothing to Disclose
Matthieu Rutten, MD, Hertogenbosch, Netherlands (Presenter) Nothing to Disclose
Courtney E. Scher, DO, Detroit, MI (Presenter) Nothing to Disclose
Alberto S. Tagliafico, MD, Genova, Italy (Presenter) Nothing to Disclose
Ximena L. Wortsman, MD, Santiago, Chile, (xworts@yahoo.com) (Presenter) Nothing to Disclose
Andrea Klauser, MD, Innsbruck, Austria (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Familiarize course participants with the ultrasound appearance of nerves and the scanning techniques used to image them in the distal upper extremity. 2) Emphasize the ultrasound anatomy of the median, ulnar, radial nerves and their divisional branches at the most common sites of entrapments, including the carpal tunnel and the cubital tunnel. 3) Learn the technique to image some minor nerves in their course throughout the distal upper extremity, such as the the lateral and the medial antebrachial cutaneous. 4) Outline the range of clinical conditions where ultrasound is appropriate as the primary imaging modality for nerve assessment.

ABSTRACT
In recent years, ultrasound of the musculoskeletal and peripheral nervous systems is becoming an increasingly imaging tool with an expanding evidence base to support its use. However, the operator dependent nature and level of technical expertise required to perform an adequate ultrasound assessment means that appropriate training is required. For this purpose, the present course will demonstrate the basic principles of musculoskeletal ultrasound with a special focus on nerves of the distal upper extremity (elbow to hand). The standardized techniques of performing an adequate ultrasound study of the median, ulnar, radial and their divisional branches, lateral cutaneous of the forearm and medial cutaneous of the arm and the forearm will be illustrated. The hands-on workshops will provide the opportunity to interactively discuss the role of ultrasound in this field with expert instructors. Participants will be encouraged to directly scan model patients. A careful ultrasound approach with thorough understanding of soft-tissue planes and extensive familiarity with anatomy are prerequisites for obtaining reliable information regarding the affected structure and the site and nature of the disease process affecting it.

Honored Educators
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Jon A. Jacobson, MD - 2012 Honored Educator
**Musculoskeletal Series: Current Trends in Musculoskeletal Imaging**

**Wednesday, Dec. 2 8:30AM - 12:00PM Location: E451B**

**RC504-02 MRI of Total Knee Arthroplasty: Synovial Patterns Predictive of Disease**

**Wednesday, Dec. 2 8:55AM - 9:05AM Location: E451B**

**LEARNING OBJECTIVES**

1) Identify the typical imaging features suggesting atypical musculoskeletal infection. 2) Understand the pathological basis for the imaging patterns of atypical musculoskeletal infection. 3) Detect imaging features that allow differentiation of atypical musculoskeletal infection from neoplastic lesions and virulent infection.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Mark D. Murphey, MD - 2015 Honored Educator

**PURPOSE**

To determine the sensitivity and specificity of various synovial appearances on MRI in patients with a painful total knee arthroplasty (TKA).

**METHOD AND MATERIALS**

With IRB approval, 101 consecutive patients who had knee MRI within 1 year prior to revision TKA were identified from our hospital registry of retrieved TKA implants. All MR scans were performed on a 1.5T magnet. Axial, coronal and sagittal PD, sagittal inversion recovery and MAVRIC PD MR images were retrospectively reviewed blinded to the ultimate diagnoses and the cases were categorized by the appearance of the synovium as one of the following: bulky hypertrophied synovium (suggestive of particle induced synovitis), lamellated and hyperintense (suggestive of infection), globally thickened and contracted (suggestive of arthrofibrosis), and mildly thickened with a homogenous effusion (suggestive of non-specific synovitis). The MR appearances were then compared with operative reports, microbiology, and pathology reports.

**RESULTS**

Bulky hypertrophied synovium had 69% sensitivity, 89% specificity and 94% PPV for particle induced synovitis with implant particles seen at histopathology, and 98 % sensitivity, 78% specificity and 75% PPV for an operative diagnosis of aseptic loosening, severe polyethylene wear, or osteolysis. Lamellated synovitis had 85% sensitivity, 99% specificity and 94% PPV for infection. A contracted and globally thickened synovium had 75% sensitivity, 98% specificity and 60% PPV for arthrofibrosis. A mildly thickened synovial...
appearance had 63% sensitivity, 93% specificity, and 79% PPV for stiffness, instability, and nonspecific pain as the reason for revision TKA.

**CONCLUSION**

In patients with a painful TKA, MRI appearance of the synovium can be used to differentiate between cases of particle induced wear, infection, arthrofibrosis and non-specific synovitis.

**CLINICAL RELEVANCE/APPLICATION**

MRI is predictive of various synovial pathologic conditions in TKA and may be valuable in the diagnostic workup of patients with a painful TKA.

**PURPOSE**

The diagnosis of infectious spondylodiscitis is often challenging. Alterations seen in MRI are quite sensitive, but lack specificity and the distinction from osteochondrosis is often difficult. The aim of the present study was to assess the diagnostic value of simultaneous 18F-FDG-PET/MRI in cases of suspected spondylodiscitis.

**METHOD AND MATERIALS**

In a prospective study 25 patients with suspected spondylodiscitis were enrolled. All patients underwent a simultaneous whole spine simultaneous 18F-FDG-PET/MRI scan including standard MRI sequences with/-out contrast. Image datasets were evaluated by two radiological residents with 1-5 years experience and one board certified nuclear medicine physician independently and finally in consensus. For all suspected spinal discs as well as a healthy disc SUVmean and SUVmax were determined. The diagnostic certainty of MRI data was evaluated on a five-point Likert Scale. The consensus decision was dichotomized into spondylodiscitis - no spondylodiscitis.

**RESULTS**

The inter-rater agreement between the two radiologists in regard of the MRI scans was moderate with a weighted κ=0.67 and an absolute diagnostic certainty in just 10%. With addition of the PET data, the agreement between the radiologists rose to κ=0.95 and an absolute diagnostic certainty in 50%. In one case the diagnosis changed due to the additional PET data. The final histological analysis was in all cases identical with the imaging diagnosis. There was a strong correlation between the SUVmax ratio of healthy/sick disc and the 5-point MRI rating with a R²=0.52; p<0.001. In a ROC analysis a SUVmax ratio of 2.89 had a 100% specificity and sensitivity with an AUC of 1 for the correct diagnosis. Neither level of CRP nor leukocyte count could show a significant correlation to the spondylodiscitis diagnosis.

**CONCLUSION**

Simultaneous 18F-FDG-PET/MRI for the detection of Spondylodiscitis seems to be feasible and is increasing the diagnostic certainty in an often challenging imaging diagnosis.

**PURPOSE**

Articular cartilage injuries are very common among NFL players. In retired NFL players, early onset of OA was found to be three times higher than the general population. Delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) has been shown to quantify regional variations of glycosaminoglycan (GAG) concentrations within the cartilage. The goal of this pilot study is to determine the cumulative effects of multiple years of play on cartilage microarchitecture assessed by GAG concentration variation using dGEMRIC.
**METHOD AND MATERIALS**

The MR images of both of each athlete’s knee joints were acquired using an 8-channel knee coil at a 3T system (Achieva, Philips). dGEMRIC was performed at pre- and post-contrast injection periods using a set of five fast field echo pulse sequences with multiple flip angles (4, 8, 12, 16, 20 degrees). Sagittal slices were obtained with the imaging parameters as TR/TE = 6.3/3.2 ms, resolution = 0.37 x 0.37 mm², slice thickness = 4 mm, NSA = 2. The contrast agent Magnevist was injected intravenously at a standard dose of 0.2 mmol/kg body weight. To help the contrast efficiently diffuse into the cartilage, subjects were instructed to perform joint movement for 100 minutes. The total procedure time was around 3.5 hours.

**RESULTS**

Except the MTP of the right knee at the pre-season, subjects with more years of football play retained relatively higher volume of contrast at all cartilage compartments in both pre- and post-season. At the pre-season and post-season, one year collegiate football players presented pre-season with 0.116 mM and initial post session with 0.117 mM average contrast concentration. In players with more years of experience, the measurements were elevated to 0.139 mM and 0.140 mM, respectively, both with a 20% increase. The p-value generated from student t-test did not present any significant difference at the pre-season which is probably due to the limited sample size.

**CONCLUSION**

In conclusion, playing collegiate football for a longer period of time may lead to microstructural alterations, like GAG concentration changes within the knee cartilage. The decreased GAG concentration may be indicative of a higher risk factor for articular cartilage degradation and potential development of OA.

**CLINICAL RELEVANCE/APPLICATION**

dGEMRIC can be a quantitative imaging technique to identify micro-architectural changes in cartilage health that are not observed with standard cartilage MR sequences.

**RC504-05  Use of Combined Dynamic and Quantitative MRI to Investigate the Influence of Cartilage Contact on Cartilage Morphology, Composition, and Ultra-Structure**

**Wednesday, Dec. 2 9:25AM - 9:35AM Location: E451B**

**Participants**
Jarred Kaiser, Madison, WI (Abstract Co-Author) Nothing to Disclose
Fang Liu, Madison, WI (Abstract Co-Author) Nothing to Disclose
Darryl Thelen, Madison, WI (Abstract Co-Author) Nothing to Disclose
Richard Kijowski, MD, Madison, WI (Presenter) Nothing to Disclose

**PURPOSE**

To investigate the relationship between cartilage contact and cartilage morphology, composition, and ultra-structure using combined dynamic and quantitative MRI.

**METHOD AND MATERIALS**

Four young asymptomatic volunteers underwent combined dynamic and static MRI on a 3.0T scanner. Dynamic SPGR images were continuously acquired while the subjects actively flexed and extended their knee at 0.5 Hz for 5 minutes in a custom-made loading device. Static 3D-FSE and mDESPOT bi-component T2 mapping sequences were also performed. Reconstructed kinematics were used to compute tibia contact maps which were defined as the maximum depth of penetration of the tibia cartilage mesh into the femoral cartilage mesh through the flexion-extension cycle. 3D-FSE was used to create tibia cartilage thickness maps, while mDESPOT was used to create tibia cartilage single-component T2 relaxation time (T2) maps and cartilage fast relaxing water fraction (FF) maps, the latter of which is thought to represent water bound to proteoglycan. The maps were sub-divided into 10 equal-sized regions of interest (ROI) on the medial and lateral tibia. ROI-based Pearson correlation analysis was performed between cartilage contact and cartilage quantitative MRI parameters.

**RESULTS**

Cartilage contact was greater on the medial tibia than the lateral tibia for all subjects with larger areas of positive penetration of the tibia cartilage mesh into the femoral cartilage mesh and greater maximum depth of penetration. Higher FF values were also noted in the medial tibia in all subjects, while no visible differences in the cartilage thickness and cartilage T2 maps between the medial and lateral tibia could be identified. The degree of cartilage contact was positively correlated with cartilage thickness (r=0.341, p<0.001) and cartilage FF (r=0.417, p<0.001) and negatively correlated with cartilage T2 (r=-0.211, p=0.04).

**CONCLUSION**

Cartilage is a tissue well-adapted to withstand higher compressive forces with areas exposed to greater contact being thicker and having lower T2 (likely reflecting a thicker radial zone comprised of perpendicularly oriented collagen fibers) and higher FF (likely reflecting greater proteoglycan content).

**CLINICAL RELEVANCE/APPLICATION**

Combined dynamic and quantitative MRI may be useful for investigating how biomechanical factors within the knee joint influence normal cartilage physiology and cartilage degeneration in patients with osteoarthritis.

**RC504-06  Functional Cartilage Imaging in Clinical Practice**

**Wednesday, Dec. 2 9:35AM - 10:00AM Location: E451B**

**Participants**
Christine B. Chung, MD, San Diego, CA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Emphasize the biochemical composition of articular cartilage and its relationship to intrinsic MR property. 2) Describe the normal morphologic and quantitative MR signature of articular cartilage on various pulse sequences. 3) Describe MR and clinical cartilage
grading systems. 4) Identify indications and appropriate MR protocols for cartilage evaluation, including primary chondral/ osteochondral evaluation versus cartilage evaluation as a surrogate for meniscal function.

**RC504-07 Osteochondral Injuries**

*Wednesday, Dec. 2 10:10AM - 10:30AM Location: E451B*

**Participants**
Carol L. Andrews, MD, Pittsburgh, PA (Presenter) Author, Reed Elsevier; Author, Informa PLC

**LEARNING OBJECTIVES**
1) Describe the findings of imaging of acute bone injury including radiography and MRI. 2) Recognize the bone and marrow changes see on MRI in osteopenia and hyperemia. 3) Identify the imaging findings of osteonecrosis. 4) Accurately describe the entity typically referred to as "osteochondral lesion".

**PURPOSE**

The significance of MR cartilage signal abnormalities with or without cartilage swelling (grade 1 lesions) is not well understood and previous reports in the literature are inconclusive. Purpose of our study was therefore to assess the natural evolution of different types of grade 1 cartilage lesions (G1CL) in subjects without radiographic evidence of knee osteoarthritis (OA) over 48 months in comparison to matched controls without lesions.

**METHOD AND MATERIALS**

Subjects from the Osteoarthritis Initiative (n=59; age 56.6±8.3; 56% women) with G1CL diagnosed on 3T MRIs of the right knee but without focal defects of cartilage and without radiographic evidence of OA (KL scores 0-1) were frequency matched for age, sex, baseline KL and BMI with 52 controls without any cartilage lesion (age 54.8±6.5; 58% women). Individual G1CL (n=76) on intermediate-weighted fast spine echo sequences were categorized into 4 subgrades: A=hypointense, B=inhomogeneous, C=hyperintense, D=hyperintense with swelling. After 48 months progression of cartilage and subchondral bone marrow changes was assessed. Fisher's exact test was used for group and subgrade comparisons.

**RESULTS**

At baseline G1CL were detected significantly more frequently in the patellofemoral than in the tibiofemoral joint (48 vs. 28, P=0.022), and subgrades A or B were more frequent than C or D (n=65 vs. 11, P<0.001). Across compartments, G1CL progressed in 48-67% to focal cartilage lesions, while only 2-6% of controls showed incidental focal lesions (patella: 48 vs. 6%, P<0.001; trochlea: 52 vs. 2%, P<0.001; medial femur: 67 vs. 2%, P<0.001; lateral femur: 50 vs. 2%, P=0.011; medial tibia: 50 vs. 2%, P<0.001; lateral tibia: 47 vs. 2%, P<0.001). No significant differences in progression were found between G1CL subgrades (P>0.05). Incidental bone marrow abnormalities were associated with G1CL lesions in the patella (39 vs. 2% in the controls, P<0.001), trochlea (36 vs. 2%, P<0.001) and lateral tibia (47 vs. 2%, P=0.001).

**CONCLUSION**

G1CL are precursors of more severe structural cartilage abnormalities. Reporting these signal abnormalities is therefore crucial to identify patients at risk for progressive cartilage degeneration and may impact patient management.

**CLINICAL RELEVANCE/APPLICATION**

Grade 1 cartilage lesions often progress to more severe cartilage degeneration, and diagnosis therefore may have an impact on patient management, including life style changes and cartilage repair.

**RC504-08 Grade 1 Cartilage Lesions in the Knee are Precursors of More Severe Cartilage Damage - Data from the Osteoarthritis Initiative**

*Wednesday, Dec. 2 10:30AM - 10:40AM Location: E451B*

**Participants**
Benedikt J. Schwaiger, MD, San Francisco, CA (Presenter) Nothing to Disclose
Alexandra S. Gersing, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
John Mbapte Wamba, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Michael C. Nevitt, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Charles E. McCulloch, San Francisco, CA (Abstract Co-Author) Instructor, F. Hoffmann-La Roche Ltd Expert Witness, Mallinckrodt plc Consultant, Mallinckrodt plc

**PURPOSE**

The significance of MR cartilage signal abnormalities with or without cartilage swelling (grade 1 lesions) is not well understood and previous reports in the literature are inconclusive. Purpose of our study was therefore to assess the natural evolution of different types of grade 1 cartilage lesions (G1CL) in subjects without radiographic evidence of knee osteoarthritis (OA) over 48 months in comparison to matched controls without lesions.

**METHOD AND MATERIALS**

Subjects from the Osteoarthritis Initiative (n=59; age 56.6±8.3; 56% women) with G1CL diagnosed on 3T MRIs of the right knee but without focal defects of cartilage and without radiographic evidence of OA (KL scores 0-1) were frequency matched for age, sex, baseline KL and BMI with 52 controls without any cartilage lesion (age 54.8±6.5; 58% women). Individual G1CL (n=76) on intermediate-weighted fast spine echo sequences were categorized into 4 subgrades: A=hypointense, B=inhomogeneous, C=hyperintense, D=hyperintense with swelling. After 48 months progression of cartilage and subchondral bone marrow changes was assessed. Fisher's exact test was used for group and subgrade comparisons.

**RESULTS**

At baseline G1CL were detected significantly more frequently in the patellofemoral than in the tibiofemoral joint (48 vs. 28, P=0.022), and subgrades A or B were more frequent than C or D (n=65 vs. 11, P<0.001). Across compartments, G1CL progressed in 48-67% to focal cartilage lesions, while only 2-6% of controls showed incidental focal lesions (patella: 48 vs. 6%, P<0.001; trochlea: 52 vs. 2%, P<0.001; medial femur: 67 vs. 2%, P<0.001; lateral femur: 50 vs. 2%, P=0.011; medial tibia: 50 vs. 2%, P<0.001; lateral tibia: 47 vs. 2%, P<0.001). No significant differences in progression were found between G1CL subgrades (P>0.05). Incidental bone marrow abnormalities were associated with G1CL lesions in the patella (39 vs. 2% in the controls, P<0.001), trochlea (36 vs. 2%, P<0.001) and lateral tibia (47 vs. 2%, P<0.001).

**CONCLUSION**

G1CL are precursors of more severe structural cartilage abnormalities. Reporting these signal abnormalities is therefore crucial to identify patients at risk for progressive cartilage degeneration and may impact patient management.

**CLINICAL RELEVANCE/APPLICATION**

Grade 1 cartilage lesions often progress to more severe cartilage degeneration, and diagnosis therefore may have an impact on patient management, including life style changes and cartilage repair.

**RC504-09 MR Bone Morphometry Predicts Biomechanical Property**

*Wednesday, Dec. 2 10:40AM - 10:50AM Location: E451B*

**Participants**
Betty Tran, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Shevonda Statum, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Renki Biswas, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Kyu-Sung Kwack, MD, PhD, Suwon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Robert Healey, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Won C. Bae, PhD, San Diego, CA (Presenter) Nothing to Disclose
Christine B. Chung, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Subchondral trabecular bone is often involved during knee injury and joint degeneration. MR evaluation of articular cartilage, as well as subchondral bone, would be useful clinically. Purpose of this study was to determine if MR morphometric measures of subchondral trabecular bone correlates with shear biomechanical failure.
METHOD AND MATERIALS
Nine 8.5-mm diameter osteochondral cores were harvested (Fig.A) from tibial plateau of cadaveric donors (age range 60 to 86 years old) and imaged at 3T (Fig.C) using 3D spoiled gradient echo without fat suppression at 200 micron isotropic resolution. Cores were cut axially, while recording force and displacement to determine shear energy (Fig.B). MR data was cropped to 1-mm thickness near each cut location, region of interest was selected to exclude artifacts, and standard bone morphometric analysis was performed (Fig C). Total of 19 cut locations were analyzed.

RESULTS
From MR data, 3D structure of trabeculae could be discerned (Fig.C). Many of morphometric measures, including bone volume fraction, trabecular thickness, and structure model index, correlated significantly with biomechanical shear energy (Fig.D), suggesting that higher density, thicker, and plate-like properties of the trabeculae correlated with higher shear energy needed to cut through the sample.

CONCLUSION
High resolution MRI is a useful modality not only for soft tissue evaluation, but also for quantitative evaluation of trabecular bone, which may serve as a surrogate for bone strength.

CLINICAL RELEVANCE/APPLICATION
This study has implications for evaluation of human bone structure using non-ionizing MRI modality, with applications for conditions such as subchondral bone insufficiency fracture.

RC504-10  The Role of Mechanical Stress on the Vascularization of Subchondral Bone in the Femoral Head: A DCE-MRI Study

Participants
Jean-Francois Budzik, MD, PhD, Lille, France (Presenter) Nothing to Disclose
Guillaume Lefebvre, MD, Lille, France (Abstract Co-Author) Nothing to Disclose
Helene Behal, Lille, France (Abstract Co-Author) Nothing to Disclose
Sebastien Verclytte, MD, Marcq en Baroeul, France (Abstract Co-Author) Nothing to Disclose
Pierre Hardouin, Boulogne-Sur-Mer, France (Abstract Co-Author) Nothing to Disclose
Anne Cotten, MD, Lille, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
To assess the normal perfusion pattern of subchondral bone in the femoral head with Dynamic Contrast Enhanced (DCE)-MRI and to study the influence of mechanical stress.

METHOD AND MATERIALS
This prospective study was approved by our Institutional Review Board. Informed Consent was obtained. DCE-MRI of the right hip was performed in sixty adults (32 women, 28 men) between April and September 2014. Mean age was 37.5 (±12.5). Regions of interest (ROI) were deposed in the center and in subchondral areas of the femoral head. Semi-quantitative and pharmacokinetic parameters were calculated. Perfusion parameters were compared between ROIs using a linear mixed model. Associations of each perfusion parameter with age, sex, body mass index (BMI) were studied using analysis of covariance models; age and sex were systematically introduced into models.

RESULTS
Semi-quantitative and pharmacokinetic parameters were different between the center of the femoral head and supero-lateral, antero-superior and posterior subchondral zones (p≤0.028). Parameters in the inferior zone differed from those of the supero-lateral and antero-superior zones (p≤0.029). BMI was negatively correlated with Time To Peak in all zones (p≤0.041). BMI was positively correlated with Ktrans and Ve values in all zones except the inferior (p≤0.035). Ve values were inferior in women in every zone (p≤0.039). Ktrans and Ve values were negatively correlated with age in posterior and inferior zones (p≤0.039).

CONCLUSION
This study demonstrates that the perfusion of subchondral bone is not homogeneous within the femoral head. Our results suggest that mechanical stress influences the microvascular properties of subchondral bone marrow.

CLINICAL RELEVANCE/APPLICATION
The proposed role of mechanical stress on the microvascularization of subchondral bone offers new opportunities in osteoarthritis research.

RC504-11  Metatarsophalangeal Joint Instability

Participants
Hilary R. Umans, MD, Airdsley, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
Overview of lesser metatarsophalangeal joint (MPJ) plantar plate (PP) and capsular degeneration and tear and discuss how it relates to MPJ instability. Lesser MPJ Anatomy Symptoms / Exam MPJ region pain, Sub-metatarsal Tenderness, esp planter lateral base toe proximal phalanx Webspace Toe deformity Deviation, esp tibial +/- splaying 2nd-3rd toes Axial loading at MPJ Etiology of PP and Capsular ligament degeneration + tear Chronic stress >> common than acute trauma Hyperextension + Axial loading high heels Crowding narrow toebox HAV + 2nd metatarsal (MT) protrusion Synovitis stretches MPJ capsule, leading to laxity and MPJ instability degeneration at the phalangeal insertion of the MPJ PP Traumatic tear less common PP tear pattern esp 2nd toe MPJ esp lateral insertion Frequent assoc’d tear of the lateral capsule Clinical grading MPJ Instability Vertical stress test Digital Purchase Paper pull-out test Toe deformity Deviation, splaying, hyperextension Natural history: worsening deformity and dysfunction Imaging
MRI Without vs with IV gadolinium Bright T2 signal defect at insertion +/- enhancement Enhancing defect +/- corresponding bright T2 signal defect Normal midline Hi Signal zone up to 2.5 mm Elongation = pathologic US Tear = hypoechoic defect at insertion Normal midline hypoechoic zone = 2.5mm Widens with degeneration + tear MRI vs US MRI Static exam Global Overview Can evaluate the capsule More easily DDx b/t pericapsular reactive soft tissue thickening (fibrosis +/- edema) + web space neuroma US Dynamic exam Assess focal tenderness + MPJ instability Technically challenging / learning curve Image incrementally from medial - lateral insertion DDx pericapsular fibrosis from workspace neuroma US Pitfalls Mostly anisotropy due to non-parallel imaging Can mistake midline hypoechoic zone for tear Limitations Sensitive, Not specific Difficult to differentiate degeneration vs tear MPJ capsule cannot be evaluated Tx Options Conservative measures Taping Padding Rest NSAIDs Avoid steroid injection near the plantar plate insertion Surgery 2 approved surgical devices / approaches for repair of the PP via a dorsal incision Mini-Scorpion Device Incorporates Weil osteotomy with Plantar Plate repair Limited favorable outcomes Hat-trick System No osteotomy Unilateral or Bilateral Recently approved

**ABSTRACT**

**RC504-12 Chronic Wrist Symptoms in Correlation with Abnormal Scapholunate Joint Kinematics in Four-Dimensional CT Examinations: Initial Clinical Experience**

**Wednesday, Dec. 2 11:25AM - 11:35AM Location: E451B**

**Participants**

Nima Hafezi Nejad, MD, MPH, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

John N. Morelli, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Uma Thakur, MD, Watchung, NJ (*Abstract Co-Author*) Nothing to Disclose

Scott D. Lifchez, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

Kenneth R. Means JR, MD, Baltimore, MD (*Abstract Co-Author*) Speakers Bureau, Auxilium Pharmaceuticals, Inc Faculty, IntegrLifeSciences Holdings Corporation

Jaimie Shores, MD, Baltimore, MD (*Abstract Co-Author*) Consultant, AxxoGen, Inc Stockholder, MDConnectME

Shadpour Demehri, MD, Baltimore, MD (*Presenter*) Research support, General Electric Company; Researcher, Carestream Health, Inc; Consultant, Toshiba Corporation

**PURPOSE**

Using Four Dimensional CT scan (4D-CT) we aimed at showing abnormal kinematics of Scapholunate (SL) interval in symptomatic wrists with inconclusive radiographic findings, compared to 4D-CT examinations of asymptomatic contralateral wrists.

**METHOD AND MATERIALS**

This is an IRB approved, HIPPA complaint, retrospective study of wrist 4D-CT scans of patients who were referred for further evaluation of chronic wrist pain (> 3 months). In all, 12 symptomatic wrists (11 subjects) with chronic symptoms and inconclusive radiographs and 10 asymptomatic contralateral wrists were scanned using 4D-CT. SL interval was measured during three wrist motions: relaxed to clenched fist, flexion to extension, and radial to ulnar deviation. Change in SL interval measurements after each motion was recorded using double-oblique multiplanar reformation technique.

**RESULTS**

We extracted the normal limits of SL interval during active motion in symptomatic and asymptomatic wrists. While the SL interval is expected to be smaller than 1 mm in asymptomatic wrists (except for the clenched fist: 0.51 - 1.34 mm), symptomatic wrists present with SL interval of larger than 1 mm. In fact in clenched fists (2.53 ± 1.19 mm), or during extension (2.54 ± 1.48 mm) or ulnar deviation (2.06 ± 1.12 mm), average expected SL interval in symptomatic wrists is more than 2 mms. No change in SL interval measurements was detected during all the three wrist motions in asymptomatic contralateral wrists. In contrast, SL intervals increased while moving from relaxed to clenched (0.70; 0.24 - 1.16 mm; p= 0.01), from flexion to extension (1.04; 0.26 - 1.81 mm; p= 0.01) and from radial to ulnar deviation (0.48; - 0.03 - 1.00 mm; p= 0.06). There was a moderate correlation between SL interval change and presence/absence of symptoms (Spearman Rho: 0.45 - 0.65)

**CONCLUSION**

Compared to asymptomatic wrists, SL interval measurements significantly increase during active motion in symptomatic wrists with inconclusive plain radiographs using 4D-CT examination.

**CLINICAL RELEVANCE/APPLICATION**

4D CT of the wrist is suitable and clinically feasible to detect subtle motion abnormality suggestive of SLIL insufficiency in patients with chronic wrist pain. This study shows how SL motion abnormalities is associated with presence of symptoms. Moreover, it reports different SL interval limits that are expected in asymptomatic and symptomatic wrists.

**RC504-13 Dynamic Ultrasound of Upper Extremity**

**Wednesday, Dec. 2 11:35AM - 12:00PM Location: E451B**

**Participants**

Mary M. Chiavaras, MD, PhD, Ancaster, ON (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

To understand indications, learn technique, and review associated anatomy for dynamic ultrasound imaging of the shoulder, elbow, wrist, and hand.
Techniques of Musculoskeletal Interventional Ultrasound (Hands-on)

Wednesday, Dec. 2 8:30AM - 10:00AM Location: E263

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Veronica J. Rooks, MD, Honolulu, HI (Moderator) Nothing to Disclose
Peter L. Cooperberg, MD, Vancouver, BC (Presenter) Nothing to Disclose
Aida F. Cossi, MD, Boston, MA (Presenter) Nothing to Disclose
Nathalie J. Bureau, MD, MSc, Montreal, QC, (nathalie.bureau@umontreal.ca) (Presenter) Equipment support, Siemens AG
James W. Murakami, MD, Columbus, OH (Presenter) Nothing to Disclose
Michael A. Mahlon, DO, Tacoma, WA (Presenter) Nothing to Disclose
Paolo Minafra, MD, Pavia, Italy, (paolominafra@gmail.com) (Presenter) Nothing to Disclose
Paula B. Gordon, MD, Vancouver, BC (Presenter) Stockholder, OncoGenex Pharmaceuticals, Inc ; Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Reallimed
Hollins P. Clark, MD, MS, Winston Salem, NC (Presenter) Nothing to Disclose
Carmen Gallego, MD, Madrid, Spain, (cgallego@salud.madrid.org) (Presenter) Nothing to Disclose
Mabel Garcia-Hidalgo Alonso, MD, Madrid, Spain (Presenter) Nothing to Disclose
Michael A. Dipietro, MD, Ann Arbor, MI (Presenter) Nothing to Disclose
Horacio M. Padua JR, MD, Boston, MA (Presenter) Nothing to Disclose
Patrick Warren, MD, Columbus, OH (Presenter) Nothing to Disclose
Stephen C. O’Connor, MD, Boston, MA (Presenter) Nothing to Disclose
Sara E. Smolinski, MD, Springfield, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography, with specific focus on musculoskeletal applications.
2) Define and discuss technical aspects, rationale, and pitfalls involved in musculoskeletal interventional sonographic care procedures.
3) Successfully perform basic portions of hands-on US-guided MSK procedures in a tissue simulation learning module, to include core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, soft tissue foreign body removal, and intraarticular steroid injection.
4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional MSK sonographic learning opportunities.

ABSTRACT
Ultrasound Guided Foreign Body Removal: Simulation Training and Clinical implementation Outcomes Purpose: USFBR can be taught to radiologists to generate competency, and radiologists can apply the technique in the patient setting to remove foreign bodies.
Materials and Methods: Proof of concept was performed by a radiologist and surgeon removing nine 1-cm foreign bodies using the USFBR method (P) and traditional surgery (S) with and without wire guidance (W) on the cadaver model. Next, USFBR was taught to 48 radiologists at 4 hospitals. Training included didactic and hands-on instruction covering 7 components: instrument alignment, hand/transducer position, forceps use, foreign body definition, forceps grasp, recognition of volume averaging, and oblique cross cut artifact. Pre-training testing assessed single toothpick removal from turkey breast in 15 minutes. Post-training evaluation consisted of 5 toothpick removals. Ongoing clinical implementation data of USFBR by trained radiologists are being collected. Parameters including age of patient, which radiologist, removal success, type and size of foreign body, incision size, foreign body retention time, reason for removal, symptoms, modalities used in detection, wound closure, and sedation are recorded. Data analyzed using chi-squared and Fisher’s exact tests for categorical outcomes and analysis of variance for continuous outcomes.
Results: USFBR technique shows a higher success rate and smaller incision size in comparison to surgical technique alone in the cadaver. Removal success: P 100%, S 78%, and W 89%. With USFBR training, radiologists’ scores improved from 21-52% pre-training to 90-100% post-training (p<0.001 for each component). In the clinical setting to date, USFBR has been 100% successful in 7 of 25 expected patients, ages 9–73 years, by four radiologists. Parameters included: length 4 to 30 mm, retention 2 to 864 days, incision, 2 to 8 mm. 1 suture closure. 1 sedation. Conclusion: USFBR is superior to non-guided surgical technique. The USFBR approach taught in simulation improves radiologist technique and removal outcomes. A radiologist who completes simulation training can remove a variety of imbedded foreign bodies.
PEARLS AND PITFALLS IN MSK RADILOGY

Wednesday, Dec. 2 8:30AM - 10:00AM Location: N227

MK MR

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC551A MRI of Arthroplasty: How to Do It

Participants
Hollis G. Potter, MD, New York, NY (Presenter) Research support, General Electric Company

LEARNING OBJECTIVES
1) To become familiar with different patterns of abnormal synovial response around implants. 2) To become familiar with protocols using standardized and newer sequences which optimize tissue contrast and provide accurate diagnosis.

ABSTRACT
MRI characteristics of adverse local tissue reactions, periprosthetic infection, and component loosening will be reviewed. Characteristics of osteolysis will also be discussed, as well as additional complications of joint arthroplasty.

RC551B MRI of Bone Marrow: What's Normal What's Not?

Participants
Miriam A. Bredella, MD, Boston, MA, (mbredella@mgh.harvard.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Differentiate normal variations in MRI appearance of bone marrow from malignant marrow infiltrative disorders. 2) Become familiar with the MRI appearance of age-related and post-treatment changes of bone marrow.

ABSTRACT
MRI characteristics of normal bone marrow will be reviewed, including changes related to aging and therapy. Imaging examples of benign and malignant disorders affecting bone marrow will be reviewed including pitfalls in MRI interpretation of bone marrow.

RC551C Tumors and Tumor-like Lesions of the Musculoskeletal System: Pearls and Pitfalls for the General Radiologist

Participants
Behrang Amini, MD, PhD, Houston, TX, (bamini@mdanderson.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Become familiar with the imaging appearance of common and uncommon presentations of benign and malignant musculoskeletal lesions. 2) Know how to manage indeterminate focal bone and soft tissue abnormalities.

ABSTRACT
Radiologists are often challenged by the overlap in the imaging appearance of benign and malignant musculoskeletal lesions. The imaging appearance of challenging bone and soft tissue lesions will be reviewed. Suggestions will be made for management with the aim of balancing patient safety with the burden of further investigation or intervention.
Dynamic Musculoskeletal US: Clicks and Clunks of the Lower Extremity (Hands-on)

Wednesday, Dec. 2 8:30AM - 10:00AM Location: E264

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

LEARNING OBJECTIVES

1) Identify anatomic structures which can impinge or move abnormally in the hip and ankle causing pain during normal range of motion. 2) Describe the ultrasound anatomy and scanning technique for a dynamic examination of these lesions. 3) Position patients optimally for the dynamic evaluation of the hip and ankle respecting ergonomics.

ABSTRACT

This course will demonstrate standardized techniques of performing the dynamic examination of hip and ankle lesions that are only or best demonstrated dynamically. These include the snapping hip, peroneal tendon subluxation/dislocation, flexor hallucis longus impingement, and ankle ligament instability. In the first portion of the course, probe positioning will be demonstrated on a model patient with overhead projection during live scanning. In the second portion of the course, an international group of expert radiologists will assist participants in learning positioning and scanning of hip and ankle joint lesions described. An emphasis on dynamic maneuvers and ergonomic documentation of tissue dynamics will be taught. Participants will be encouraged to directly scan model patients.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jon A. Jacobson, MD - 2012 Honored Educator
Musculoskeletal Wednesday Poster Discussions

Wednesday, Dec. 2 12:15PM - 12:45PM Location: MK Community, Learning Center

MK

A New Classification System for Knee Fat Pad Impingement Syndrome

Station #1

Participants
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (Moderator) Advisory Board, Siemens AG; Consultant, Medtronic, Inc

Sub-Events

MK356-SD-WEA1 A New Classification System for Knee Fat Pad Impingement Syndrome

Participants
Waqar A. Bhatti, MBChB, Manchester, United Kingdom (Presenter) Nothing to Disclose
Guilaiz S. Ahmad, MBChB, Manchester, United Kingdom (Abstract Co-Author) Nothing to Disclose
Shahrukh R. Ahmad, Manchester, United Kingdom (Abstract Co-Author) Nothing to Disclose
Muhammad Mubashar, MBBS, FRCP, Manchester, United Kingdom (Abstract Co-Author) Nothing to Disclose
Reda Brahmi Chaouch, MD, Manchester, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

Fat pad impingement syndrome of the knee is a frequent cause for anterior knee pain and increasingly being recognised by radiologist on reading MRI scans. Definitive diagnosis will aid in management. We describe a simple classification system for describing fat impingement syndrome and how it influences management.

METHOD AND MATERIALS

Systematic review of MRI examinations of the knees frequently reveal findings of fat pad impingement. Supralateral Hoffa fat pad impingement and quadriceps fat pad impingement appeared to be the most frequent findings. On review of 200 MRI examinations of the knee we have developed a classification system for describing fat pad impingement syndrome based on signal characteristic criteria seen on the T1 and PD fat sat images. This has an implication on management of this common condition.

RESULTS

Review of the MR examination revealed three patterns for fat pad Impingement. Stage I reveals normal signal characteristics on T1 W images and patchy increase signal on the fat suppressed fluid sensitive sequences. Stage II disease reveals abnormal low signal on the T1 W images and increase signal intensity on the fat suppressed fluid sensitive sequences. Stage III disease reveals nodular fatty pad impingement with uniform low signal on T1 W and diffuse high signal on the T2 W images. The significance of these findings are that stage I disease is typically with physical therapy treatment. Stage II disease has also reversible with physical therapy and may benefit from steroid injection therapy. Stage III disease which is the nodular hypertrophic form requires surgical excision as it typically interferes with the normal dynamics of the knee joint during flexion and extension.

CONCLUSION

Fat impingement is a frequent cause of anterior knee pain in the young patient. Identifying the stage of the disease is essential in the appropriate management of fat pad impingement syndrome. The Manchester model for the management of Fat pad impingment based on the grades shall be discussed.

CLINICAL RELEVANCE/APPLICATION

Fat pad impingement syndrome is commonly overlooked by the reporting radiologist. We identify the salient findings on MR examinations and provide a grading system and its potential influence on the management of this frequent cause of anterior knee pain.

MK357-SD-WEA2 The Reliability of the British Athletics Muscle (BAM) Injury Classification and Its Use in Assessing Reinjury Rates and Time to Return to Full Training (TTRTFT) in Elite Athletes

Station #2

Participants
Anish Patel, Birmingham, United Kingdom (Presenter) Nothing to Disclose
Julian K. Chakraverty, MB, MCh, MRCS, Bristol, United Kingdom (Abstract Co-Author) Nothing to Disclose
Noel Pollock, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Robin Chakraverty, Birmingham, United Kingdom (Abstract Co-Author) Nothing to Disclose
Steven L. James, Birmingham, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

Injuries involving the hamstrings are commonly encountered in high-level athletes. Current muscle injury classification systems have limited ability to provide prognostic information and guide clinical management. The BAM describes acute muscle injuries based on Magnetic Resonance Imaging parameters of injury extent. It grades injury (0-4) and sub classifies location based on a myofascial, musculotendinous or intratendinous site. Aims: To implement and validate the BAM classification in the assessment of hamstring injuries in track and field athletes. To assess re-injury rates and time to return to full training (TTRTFT) in the different BAM classifications for hamstring injuries sustained over a 4 year period.

METHOD AND MATERIALS

To assess reliability: 65 hamstring injuries in 45 high level athletes were retrospectively classified by 2 radiologists at 2 time points.
4 months apart to determine interrater variability, intrarater variability and feasibility of the classification system. To assess re-injury rates and time to return to full training, 65 hamstring injuries identified and graded according to the BAM classification. TTRTFT and re-injury occurrence was recorded for each injury.

RESULTS

Interrater Kappa values of 0.80 (95% CI 0.67-0.92; P < 0.0001) for Round 1 and 0.88 (95% CI = 0.76-1.00; P < 0.0001) for Round 2 were measured. The intrarater Kappa value for the two reviewers were 0.76 (95% CI 0.63-0.88; P < 0.0001) and 0.65 (95%CI 0.53-0.76; P < 0.0001) and the average was 0.71 suggesting substantial overall agreement. TTRTFT was different between the BAM grades with grade 3 injuries and ‘c’ injuries taking significantly longer than grade 0 (p<0.001). There were 12 re-injuries of which 10 were in either BAM 2c or 3c (intratendinous). There was a highly significant increased re-injury rate in classification ‘c’ injuries (intratendinous) (p<0.001) with a re-injury rate of greater than 50%.

CONCLUSION

The BAM classification is reproducible and reliable. The application of the BAM classification highlights the importance of identifying hamstring injuries that extend into the tendon. These injuries have a different re-injury rate and TTRTFT profile.

CLINICAL RELEVANCE/APPLICATION

Injuries that extend into the tendon have higher rates of re-injury and TTRTFT. Identification of intratendinous injuries allows for a more tailored approach to rehabilitation and better prediction of TTRTFT and competition.

Mk358-sd-station #3 Evaluation of Muscle Function of the Lower-leg Using Simultaneous Acquisition of Transvers Relaxation, Perfusion, and Diffusion Information

Participants

Makoto Terazono, Kanazawa, Japan (Presenter) Nothing to Disclose
Toshiaki Miyati, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Naoki Ohno, PhD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Shuya Fujihara, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Shuto Suzuki, Kanazawa-shi, Japan (Abstract Co-Author) Nothing to Disclose
Yuki Koshino, Kanazawa-shi, Japan (Abstract Co-Author) Nothing to Disclose
Toshitaka Aoki, BS, RT, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose
Toshifumi Gabata, MD, Kanazawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

Transverse relaxation rate (R2), blood flow (MBF), and water diffusion of the lower-leg muscle under stress such as plantar flexion exercise are useful to assess the muscle functions. However, it is difficult to obtain all of them at one examination because skeletal muscle function after exercise changes quickly. Therefore, to simultaneously acquire information on R2, MBF, and restricted water diffusion in the lower leg under stress, we devised a method using spin-echo diffusion echo-planar imaging (SE-diffusion-EPI) with different echo times (TE), and compared these values before and after the exercise.

METHOD AND MATERIALS

On a 3.0-T MRI, we obtained transverse diffusion-weighted images of the lower leg using SE-diffusion-EPI before and after plantar flexion exercise at one time per second for one minute in healthy volunteers (n=12). The SE-diffusion-EPI was consecutively performed using TE of 39.2 ms with b value of 0 s/mm², and TE of 61.2 ms with b values of 0 to 800 s/mm² (0, 10, 30, 50, 100, 200, 300, 400, 500, 600, 700, and 800 s/mm²). We then calculated R2 from different TE images with b value of 0 s/mm² in each lower-leg muscle. Moreover, we also calculated the restricted diffusion coefficient (ACDr), perfusion-related diffusion coefficient (ADCp: corresponding to MBF), and its fraction (Fp) from biexponential signal decay curves in each muscle.

RESULTS

R2, ADCr, ADCp, and Fp of the tibialis anterior of the lower-leg muscle after the exercise were significantly higher than those before the exercise. On the other hand, there was no significant correlation among R2, ADCr, ADCp, and Fp of the tibialis anterior, indicating these values do not necessarily provide the same kind of information.

CONCLUSION

Our method makes it possible to simultaneously obtain R2, MBF, and restricted water diffusion in lower leg under stress, thereby increasing amount of the muscle functional information.

CLINICAL RELEVANCE/APPLICATION

Our method makes it possible to simultaneously obtain R2, MBF, and restricted water diffusion in lower leg under stress, thereby increasing amount of the muscle functional information.

Mk359-sd-station #4 SIFK (SONK): Grading, Risk Factors and Outcome

Participants

Felix Gonzalez, MD, Philadelphia, PA (Presenter) Nothing to Disclose
Mika T. Nevalainen, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Johannes B. Roedl, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

PURPOSE

To propose an MRI grading system for SIFK (subchondral insufficiency fracture of the knee, formerly SONK). To predict outcome
The presence alone of MRI abnormalities in the small posterior joints of the spine does not help to distinguish between DISH and SpA. However when abnormal, the pattern of involvement of the CVJ may help to distinguish between these two entities.
To define high-frequency ultrasound features of benign and malignant skin lesions, correlating them with the pathological findings. To emphasize the utility of ultrasounds in the diagnosis, the medical or surgical treatment planning, and the recurrence prevention of many skin conditions.

1. Sonoanatomy of the skin
2. What has to be included in the report
3. Focal benign lesions
   - Epidermal inclusion cyst
   - Pilonidal cyst
4. Non-dermatological ultrasound findings
   - Fat necrosis
   - Hematomas
   - Others: Hyperkeratosis vs papilloma, Piezogenic pedal papules, Chondrodermatitis nodularis helicis, gangrenosum
   - Dermatofibroma
   - Glomus tumor
   - Leiomyoma and angioleiomyoma
   - Neurofibromas
   - Vascular malformations
   - Traumatic
5. Skin adnexal derived: Trichilemmal cyst, Pilomatricoma, Hidradenitis, Dermal eccrine cylindroma, Eccrine hidradenoma

Metal artifacts have been an important limitation for musculoskeletal CT interpretation for postoperative studies of patients with implants after osteosynthesis and joint replacement surgery. With the advent of dual energy equipment and monoenergetic reconstructions new strategies to reduce metal artifact are provided. The images are less affected by beam-hardening artifact and provide more accurate data than standard single-energy CT images do.

Metal artifac reduction and image quality were rated superior in high energy monochromatic compared with polychromatic images and, within these, 140 kV was better than 80 and 120 kV.

Metal artifacts have been an important limitation for musculoskeletal CT interpretation for postoperative studies of patients with implants after osteosynthesis and joint replacement surgery. With the advent of dual energy equipment and monoenergetic reconstructions new strategies to reduce metal artifact are provided. The images are less affected by beam-hardening artifact and provide more accurate data than standard single-energy CT images do.

Higher metallic artifact and worse image quality are seen at 80 kV and both decreases by increasing the kilovoltage. The best results being obtained at 140 kV as well as in monochromatic series. The interobserver agreement was (artifact rs = 0.73 - 0.95 and quality image rs = 0.77 - 0.93). Artifact severity (Artifact Index): 14.16 (80 kV), 11.01 (120 kV), 7.74 (140kV), 6.36 (110 keV), 5.5 (130 keV) and 4.94 (150 keV). All results presented statistical significant differences (p <0.05), except for 130 and 150 keV which had comparable results.

CONCLUSION
Metal artifac reduction and image quality were rated superior in high energy monochromatic compared with polychromatic images and, within these, 140 kV was better than 80 and 120 kV.

Clinical Relevance/Application
Metal artifacts have been an important limitation for musculoskeletal CT interpretation for postoperative studies of patients with implants after osteosynthesis and joint replacement surgery. With the advent of dual energy equipment and monoenergetic reconstructions new strategies to reduce metal artifact are provided. The images are less affected by beam-hardening artifact and provide more accurate data than standard single-energy CT images do.

Comparison of Polychromatic and High Energy Monochromatic Images

1. Sonoanatomy of the skin
2. What has to be included in the report
3. Focal benign lesions
   - Epidermal inclusion cyst
   - Pilonidal cyst
4. Non-dermatological ultrasound findings
   - Fat necrosis
   - Hematomas
   - Others: Hyperkeratosis vs papilloma, Piezogenic pedal papules, Chondrodermatitis nodularis helicis, Semicircular lipoatrophy, Pretibial myxedema
5. Malignant tumors
   - Basal cell carcinoma
   - Squamous cell carcinoma
   - Malignant melanoma
   - Merkel cell carcinoma
   - Dermatofibrosarcoma protuberans
   - Kaposi's sarcoma
   - Vascular tumors
   - Cutaneous metastases
   - Hematologic disease: Cutaneous lymphoma, leukemia
   - Diffuse conditions: Psoriasis
   - Scleroderma
   - Exogenous components: Foreign bodies, Metal artifacts

Metal artifac reduction and image quality were rated superior in high energy monochromatic compared with polychromatic images and, within these, 140 kV was better than 80 and 120 kV.
**TEACHING POINTS**

1. Myxoid soft tissue tumors are a heterogeneous group that have variable biologic behavior, ranging from completely benign lesions, to those with a tendency to be locally aggressive and those with metastatic potential.  
2. Since imaging features include hyperintensity on fluid-sensitive sequences that may mimic a cyst, post-contrast T1 weighted imaging as well as functional sequences (dynamic contrast enhancement, diffusion weighted imaging) provide important clues to the diagnosis.  
3. Categorizing these lesions with imaging is not possible in all cases, but radiologists should be aware of important features to clinical management.

**TABLE OF CONTENTS/OUTLINE**

1. **OVERVIEW OF MYXOID LESIONS**  
   a. Benign  
   b. Locally Aggressive  
   c. Malignant  
2. **IMPORTANT HISTOLOGIC FEATURES**  
   Round cell vs spindle cell types  
3. **IMAGING FEATURES**  
   a. Anatomic sequences (T1, Fluid-sensitive, static post-contrast T1 imaging)  
   b. Functional sequences (Diffusion weighted imaging/ADC mapping, Dynamic contrast-enhanced sequences)  
4. **CLINICAL PRESENTATION AND PROGNOSIS**

**MK227-ED-WEA9 Advanced Imaging of Shoulder Arthroplasty: Pre and Postoperative Assessment**

Station #9

Participants  
Jeffrey D. Poot, DO, Hamburg, PA (Presenter) Nothing to Disclose  
Jonelle M. Petscavage-Thomas, MD, MPH, Hummelstown, PA (Abstract Co-Author) Consultant, Medical Metrics, Inc  
Eric A. Walker, MD, Hershey, PA (Abstract Co-Author) Research Consultant, Medical Metrics, Inc  
Stephanie A. Bernard, MD, Hershey, PA (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

Describe preoperative planning, indications, and postoperative assessment of shoulder arthroplasty. Describe important measurements with CT and MRI related to shoulder arthroplasty. Describe role of ultrasound for evaluation of post replacement tears.

**TABLE OF CONTENTS/OUTLINE**

Describe the preoperative assessment of shoulder arthroplasty to include the condition of the glenoid, glenoid version measurements, as well as location of both anterior and posterior maximum glenoid bone loss. Discuss indications, postoperative appearance, and related complications of anatomic total shoulder arthroplasty, reverse total shoulder arthroplasty, humeral head resurfacing, hemiarthroplasty, and nonprosthetic glenoid resurfacing. Discuss role of ultrasound for post replacement tears.

**MK298-ED-WEA10 Atypical Calcific Tendinitis/Periarthritis (CTP): A Cased-based Exploration of Atypical Presenting Locations of CTP Including a Review of the Pathogenesis, Clinical Presentation, Imaging Features and Modern Treatment Options of CTP.**

Station #10

Participants  
Garrett L. Simmons, MD, Houston, TX (Presenter) Nothing to Disclose  
Nicholas M. Beckmann, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

1. Discuss the pathogenesis and clinical presentation of calcific tendinitis/periarthritis (CTP).  
2. Review typical imaging appearance of CTP through shoulder/greater trochanter CTP examples.  
3. Demonstrate how these typical imaging characteristics are also seen in cases of CTP in atypical locations, facilitating confident diagnosis of CTP in future cases.  
4. Compare/contrast imaging features of CTP with potential CTP mimickers like infection or trauma, also facilitating confident diagnosis of CTP.  
5. Review treatment options with emphasis on technique for performing barbotage aspiration, including a discussion of the efficacy of each.

**TABLE OF CONTENTS/OUTLINE**

1. Pathogenesis and clinical presentation of calcific tendinitis/periarthritis (CTP).  
2. Typical appearance CTP on imaging, including features seen on xray, US, MRI and CT.  
3. Pictorial review of CTP in atypical locations outside the shoulder/hip.  
4. Mimickers of CTP.  
5. Treatment of CTP
Can Cartilage Compensate? How Severity of Hip Dysplasia Alters Cartilage Thickness

**PURPOSE**

Patients with developmental hip dysplasia suffer significant morbidity in part due to the instability of the hip joint. It is thought that the body compensates for this instability through hypertrophy of the articular cartilage, similar to that seen at the labrum. We aim to evaluate the relationship of cartilage thickness to the severity of hip dysplasia to better understand functionality in such patients.

**METHOD AND MATERIALS**

331 patients at our institution were evaluated for hip pain. Weight-bearing pelvic view radiographs were obtained for all patients from which the lateral center edge angle was computed. Each patient was then placed in one of four groups; dysplastic, borderline dysplastic, normal and acetabular overcoverage. An MRI was also obtained for each of these patients. Two diagnostic radiologists independently reviewed the images and calculated the cartilage thickness at the weight-bearing zone for each patient. The average joint spacing was computed for each of the 4 groups.

**RESULTS**

Cartilage thickness at the weight-bearing zone of the hip is associated with the severity of dysplasia. Patients with a lateral center edge angle of less than 20 degrees had an average cartilage thickness of 3.9 centimeters whereas patients with acetabular overcoverage, lateral center edge angle greater than 40 degrees had a cartilage thickness of only 2.7 centimeters.

**CONCLUSION**

Cartilage thickness appears to be strongly associated with the degree of hip dysplasia and likely acts as a compensatory mechanism to increase stability in a manner similar to labral hypertrophy. The effects of these findings on outcome after hip preservation warrant further exploration.

**CLINICAL RELEVANCE/APPLICATION**

Maximizing patient outcome in hip preservation surgery requires a thorough understanding of joint function, including joint stability which appears to be in part due to cartilage hypertrophy.

Disproportionate Fluid Sign: Usefulness in Diagnosis of High Grade Bursal-Sided Supraspinatus Tendon Tear Misinterpreted As Full-thickness Tear

**PURPOSE**

To determine the usefulness of the disproportionate fluid sign in diagnosing high grade bursal-sided partial-thickness supraspinatus tendon tear misinterpreted as full-thickness tear on conventional MRI.

**METHOD AND MATERIALS**

The institutional review board approved this retrospective study and waived the requirement for informed consent. This study included 231 patients with arthroscopically confirmed high-grade bursal-sided tears (n=85) and full-thickness tears (n=146) who underwent preoperative shoulder MRI from October 2007 to October 2013. The disproportionate fluid sign was defined as the prominent subdeltoid or subacromial-subdeltoid bursal fluid distension with a relative paucity of effusion in the glenohumeral joint. Two readers independently reviewed MR images twice, 4 weeks apart, for the presence of high grade bursal-sided tear by using tear depth alone and in combination with disproportionate fluid sign. The sensitivity, specificity, accuracy, and the area under the receiver operating characteristic curve(AUCs) were calculated. The McNemar test for comparison and the κ statistic for inter/intra-observer reliability was used.
RESULTS
The disproportionate fluid sign was found in 80 (34.6%) of 231 shoulders, including 69 (81.2%) of 85 bursal-sided tears and 11 (7.5%) of 146 full-thickness tears. For each reader, both the sensitivity and accuracy of the diagnoses were significantly higher in combination with the disproportionate fluid sign compared with using tear depth alone (p < .001). Interobserver agreement for the diagnosis of a bursal-sided tear was excellent (κ = .832, p < .001). The AUCs of both readers were significantly higher in combination with the disproportionate fluid sign (reader 1: 0.899 to 0.936, p = .003; reader 2: 0.943 to 0.974, p = .032).

CONCLUSION
The disproportionate fluid sign was a common finding on shoulder MRI revealing a high grade bursal-sided supraspinatus tendon tear compared with a full-thickness tear. The disproportionate fluid sign could be an indication of the presence of a high grade bursal-sided tear mimicking a full-thickness tear and significantly improved the diagnostic performance, being especially helpful for less experienced radiologists and orthopedic surgeons.

CLINICAL RELEVANCE/APPLICATION
Disproportionate fluid sign as an indication of the presence of a high grade bursal-sided tear mimicking a full-thickness tear could be helpful for even less experienced radiologists and orthopedic surgeons.

MK364-SD- WEB3 Rotator Cable Morphologic Parameters at MRI in Patients with Symptomatic Full-thickness Rotator Cuff Tears: Correlation with Functional Outcomes and Health-related Quality Of Life

Participants
Maguy Deslauriers, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Marianne Lepage-Saucier, MD, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Patrice Tetreault, MD, MSC, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Dominique Rouleau, MD, MSC, Montreal, QC (Abstract Co-Author) Nothing to Disclose
Nicola Hagemeister, Montreal, QC (Abstract Co-Author) Research collaboration, Emovi Inc Research Grant, Emovi Inc
Nathalie J. Bureau, MD, MSC, Montreal, QC (Presenter) Equipment support, Siemens AG

PURPOSE
Determinants of functional impairment in patients with rotator cuff tears (RCT) remain incompletely elucidated. Our primary aim was to correlate rotator cable (RC) morphologic parameters at MRI with functional and health-related quality of life outcomes in patients with full-thickness RCT.

METHOD AND MATERIALS
This study was IRB approved. Two MSK radiologists reviewed in consensus, 57 shoulder MRI studies from 57 patients (mean age 57 ± 6.5 years; 58% men) with RCT and 30 shoulder studies from 30 asymptomatic subjects (56 ± 7.3 years; 57% men). These parameters were evaluated: supraspinatus (SS) and infraspinatus (IS) tear dimensions (length, width, thickness); SS and IS myotendinous junction retraction; RC dimensions (width, thickness) and distance from the greater tuberosity (RC position); integrity of anterior and posterior RC attachments; markers of shoulder function (SS atrophy, SS and IS fatty infiltration). A physical therapist administered the Constant, QuickDASH and SF12-v2 questionnaires. Univariate analyses were performed using appropriate tests according to the nature of the combined variables. Stepwise logistic or linear regression models were then performed to identify the best combination of parameters predicting each variable. Threshold of alpha significance was set at p < .05.

RESULTS
Univariate analyses showed that RC position was significantly associated with SS atrophy (p < 0.001) and fatty infiltration (p < 0.001). Integrity of anterior RC attachment correlated inversely with SF12 physical score (p = 0.048) and SS atrophy (p = 0.009), whereas integrity of posterior RC attachment was inversely associated with SF12 physical score (p = 0.024) and IS fatty infiltration (p = 0.006). RC parameters did not demonstrate a significant effect in the regression models. On average, the RC was significantly narrower (p < 0.001) and thicker (p = 0.008), and the distance between the RC and the greater tuberosity was greater, in RCT patients (p < 0.001).

CONCLUSION
RC parameters do not appear to be preponderant factors of functional and health-related quality of life outcomes in patients with full-thickness RCT. Full-thickness RCT promotes medial RC displacement and alters significantly its morphology.

CLINICAL RELEVANCE/APPLICATION
Our results suggest that the status of the rotator cable as assessed in this study, is not a preponderant determinant of shoulder function.

MK365-SD- WEB4 Assessment of Synovitis with FLAIR-FS Imaging (Fluid-attenuated Inversion Recovery Sequence with Fat-suppression): A Comparative Study against Contrast-enhanced MRI

Participants
Hye Jin Yoo, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Sung Hwan Hong, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ja-Young Choi, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Hye Yeon Oh, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hee-Dong Chae, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare fat-suppressed fluid-attenuated inversion recovery sequence (FLAIR-FS) with contrast-enhanced MRI for knee synovitis assessment.
**METHOD AND MATERIALS**

Twenty one individuals with knee pain underwent a 3-T MRI scanner. The protocol consisted of routine clinical sequences followed by the FLAIR-FS sequence (axial acquisition; TR/TE 9000/85~150; inversion time 2200 msec; slice thickness 3mm; acquisition time 4 minutes 50 seconds) and contrast-enhanced (CE) T1-weighted imaging (axial acquisition; TR/TE 500-790/13; matrix 448 x 269; slice thickness 3mm; acquisition time 3 minutes 50 seconds). FLAIR-FS and CE MRI images were analyzed independently by a musculoskeletal radiologist. At 5 joint sites, the synovial thickness was measured and severity of synovitis was graded on a scale from 0 to 2 using a whole-joint semiquantitative scoring system. Then, summ scores of synovitis were calculated at patient level. Diagnostic performance statistics were calculated on the site and patient levels using CE MRI as a reference standard. The summed synovitis scores and synovial thickness of FLAIR-FS were correlated with those of CE MRI.

**RESULTS**

With CE MRI as the reference standard, FLAIR-FS showed good to excellent diagnostic performance for the detection of synovitis of any severity (sensitivity, specificity and accuracy of 76, 97 and 91% respectively on site level; and 83% 100% and 95% respectively on patient level). Excellent correlation was found between FLAIR-FS and CE MRI in the assessment of summed synovitis scores and synovial thickness (Spearman's rank correlation coefficient 0.886 (p<0.001), and Pearson's correlation coefficient 0.928 (p<0.001), respectively).

**CONCLUSION**

Our results suggest that knee synovitis could be reliably diagnosed on FLAIR-FS sequence without the need for contrast agents.

**CLINICAL RELEVANCE/APPLICATION**

FLAIR-FS sequence may be a useful sequence to assess the synovial pathology with reduced risks and scan time compared to CE-MRI.

**PURPOSE**

To explore the feasibility of quantitative evaluation of lumbar intervertebral cartilage endplate using three dimensional multi-echo ultrashort echo time pulse sequence MR imaging.

**METHOD AND MATERIALS**

The images of lumbar cartilage endplate (CEP) were obtained from twenty one young volunteers by using multi-echo ultrashort echo time pulse sequence, and the image quality were evaluated from grade I to grade III in the order from poor to excellent. The T2* values of both upper and lower CEPs were measured at the lumbar artificial color maps from L1/L2 to L5/S1.

**RESULTS**

The 210 CEP images were graded as grade III. The average T2* value of upper and lower CEP was 19.76±8.41, and 30.17±17.25, respectively. The difference of CEP T2* value between upper and lower was statistically significant (t= -5.56, P<0.01).

**CONCLUSION**

Three dimensional multi-echo ultrashort echo time pulse sequence MR imaging provides an effective approach for the quantitative study of lumbar CEP.

**CLINICAL RELEVANCE/APPLICATION**

Three dimensional multi-echo ultrashort echo time pulse sequence MR imaging could be utilized in non-invasively observing the pathological process of human lumbar CEP degeneration.

**PURPOSE**

To investigate the image quality of CT-images of a metal hip prosthesis when using model-based iterative reconstruction (IMR) combined with an orthopaedic metal artefact reduction algorithm (O-MAR) at up to 80% radiation dose reduction.

**METHOD AND MATERIALS**

A water-filled phantom was used made of PMMA using the most commonly used metal hip prosthesis configuration surrounded by 18...
RESULTS

IMR shows lower noise levels at ultra-low dose compared to high-dose FBP acquisitions. Mean HUs remain constant and CNRs of unaffacted pellets are higher at a radiation dose reduction of 80% relative to current clinical practice, using iDose4. O-MAR reduces metal artefacts (p<0.005) and is most efficent when combined with IMR. At the ultra low dose of 4 mGy IMR level 1, 2 and 3 show respectively 83%, 89% and 95% lower values in noise compared to standard FBP reconstructions while maintaining constant HU values.

CONCLUSION

In current clinical practice, an average CTDIvol of 20 mGy in radiation dose is used. Thus, based on the results of this phantom study, we can conclude that with the use of IMR and O-MAR acceptable image quality parameters regarding mean HU, noise and CNR are maintained at a reduction in radiation dose of 80 % relative to the standard reconstructions technique FBP in the CT-imaging of metal hip prostheses. However, an extensive clinical study is essential, since the actual capabilities in dose-reduction cannot be determined based on this phantom study only.

CLINICAL RELEVANCE/APPLICATION

Reducing radiation dose with 80% relative to our clinical practice, IMR and O-MAR in CT-imaging of metal hip prostheses opens possibilities for more cross sectional imaging in orthopaedic implants.

MK127-ED-WEB7  Long Head Biceps Tendon Injuries of the Shoulder: Injury Biomechanics, and the Role of Imaging in Clinical Management

Station #7

Participants
Scott Sheehan, MD, Madison, WI (Presenter) Nothing to Disclose
Humberto G. Rosas, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Jason W. Stephenson, MD, Madison, WI (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1) Review the anatomy and biomechanics of the long head biceps tendon and its role in shoulder stability, utilizing 3D modeling and animation. 2) Identify the common imaging findings and associated injury mechanisms of long head biceps tendon pathology, with arthroscopic correlation. 3) Describe a simplified treatment algorithm for biceps tendon pathology, emphasizing discriminating imaging features of long head biceps tendon injuries which direct conservative and surgical approaches.

TABLE OF CONTENTS/OUTLINE

Anatomy: Long head biceps tendon (LHBT) and rotator interval Biomechanics LHBT as a noncontractile sliding tendon Role of LHBT in shoulder stability Pathophysiology and MRI and Ultrasound imaging findings of LHBT injuries, with arthroscopic correlation Tenosynovitis Tendinosis Partial tears Rupture Dislocation Imaging pitfalls and mimics of LHBT injuries Treatment approaches Significance of associated labral tears and rotator cuff tears Conservative versus surgical treatment indications and approaches Imaging guided interventions: corticosteroid injections Simplified treatment algorithm Case-based review of imaging findings and their impact on treatment

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Scott Sheehan, MD - 2014 Honored Educator
Jeffrey J. Peterson, MD - 2012 Honored Educator

MK182-ED-WEB8  Ultrasonography of Subcutaneous Nodular Lesions

Station #8

Participants
Maximilian Rauch, Bonn, Germany (Presenter) Nothing to Disclose
Gerd Stuckmann, MD, Winterthur, Switzerland (Abstract Co-Author) Nothing to Disclose
Hans H. Schmid, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Holger M. Strunk, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

• Ultrasonography (US) is an excellent diagnostic tool for the depiction of subcutaneous lesions. It is a time-saving and cost-effective technique, is well tolerated by patients and was repeatedly demonstrated to have a good accuracy in the diagnosis of incidentally detected subcutaneous nodules. • We illustrate ultrasonographic features of subcutaneous nodules including benign, malignant and non-neoplastic lesions. • Practical hints concerning dynamic US, Color Doppler and Power Doppler imaging in the characterization of cutaneous and subcutaneous lesions • Benign mesenchymal tumors (Lipoma, Leiomyom, Fibrous lesions, Nodular fasciitis) • Superficial fibromatosis • Synopsis of malignant subcutaneous tumors • Non-neoplastic
TEACHING POINTS

Describe the radiographic, CT, and MR findings of congenital tarsal coalition. Illustrate less common forms of congenital tarsal coalition. Describe treatment for tarsal coalition.

TABLE OF CONTENTS/OUTLINE

Tarsal coalition types
Congenital osseous, cartilaginous or fibrous connection between two bones
Associated clinical findings, such as rigid pes planus
Talocalcaneal Coalition
Radiographic Findings
Cross sectional findings to include CT and MR
Treatment
Calcaneonavicular Coalition
Radiographic Findings
Cross sectional findings to include CT and MR
Talonavicular
Calcaneocuboid
Cubonavicular
Navicular-first cuneiform

TEACHING POINTS

1. To review the anatomy and pathology of the infrapatellar fat pad of Hoffa.  
2. To discuss the wide spectrum of intrinsic and extrinsic conditions that can affect Hoffa's fat pad.  
3. To develop a reasonable differential diagnosis based on imaging when pathology involves Hoffa's fat pad.

TABLE OF CONTENTS/OUTLINE

1. Objectives  
2. Introduction  
3. Anatomy  
4. Pathology.  
   a. Intrinsic conditions affecting the fat pad primarily.  
   b. Extrinsic conditions affecting the fat pad secondarily.  
5. Imaging Findings  
6. Differential Diagnosis  
7. Conclusion  
8. References.
Participants
Ken L. Schreibman, PhD, MD, Madison, WI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To get a better understanding of 3 common fracture patterns in the foot/ankle: a. Ankle twisting injuries and the Weber staging system. b. Fracture/dislocations of the Lisfranc joint c. Fractures of the proximal 5th metatarsal, distinguishing between avulsion and Jones fractures.
RSNA Diagnosis Live™: Neuro and MSK

Wednesday, Dec. 2 4:30PM - 6:00PM Location: E451B

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Paul J. Chang, MD, Chicago, IL, (pchang@radiology.bsd.uchicago.edu) (Presenter) Co-founder, Stentor/Koninklijke Philips NV; Researcher, Koninklijke Philips NV; Medical Advisory Board, lifeIMAGE Inc; Medical Advisory Board, Merge Healthcare Incorporated
Gregory L. Katzman, MD, Chicago, IL (Presenter) Nothing to Disclose
Neety Panu, MD, FRCPC, Thunder Bay, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.
Common Spinal Injection Procedures for Diagnosis and Treatment of Back Pain (Hands-on)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E263

Participants
A. Orlando Ortiz, MD, MBA, Mineola, NY (Presenter) Nothing to Disclose
Bassem A. Georgy, MD, MSc, San Diego, CA (Presenter) Consultant, Johnson & Johnson; Consultant, DFINE, Inc; Stockholder, DFINE, Inc; Stockholder, Spine Solutions, Inc;
Allan L. Brook, MD, Bronx, NY (Presenter) Advisor, Johnson & Johnson Advisor, Medtronic, Inc
Afshin Gangi, MD, PhD, Strasbourg, France (Presenter) Nothing to Disclose
Todd S. Miller, MD, Bronx, NY, (Tmiller@montefiore.org) (Presenter) Nothing to Disclose
Stanley Golovac, MD, Merritt Island, FL (Presenter) Consultant, St. Jude Medical, Inc; Investigator, Vertos Medical Inc; Investigator, St. Jude Medical, Inc

LEARNING OBJECTIVES

1) Describe and demonstrate methods for patient selection, evaluation and technique for Image-guided injection procedures used in spine pain management. 2) These procedures will include epidural steroid injections, nerve root blocks, facet blocks, sacroiliac joint injections, lumbar synovial cyst therapy, radiofrequency ablations. 3) Review procedural complications and how to avoid them. 4) Discuss pertinent anatomy, instruments and pharmacology. 5) These objectives will be accomplished using didactic lectures complemented by procedure videos, supervised hands on lab work with training models and round table case discussions.

ABSTRACT

Neck and back pain complaints are very common in the general population. Radiologists can contribute to the diagnosis and management in patients who are not responding to conservative management. Spine injection procedures can frequently be performed on an outpatient basis with a brief recovery phase. These procedures are performed with imaging guidance, such as a multi-directional fluoroscope or under CT guidance, in order to correctly localize the specific anatomic sites in or about the spine for diagnostic and or therapeutic needle localization. An understanding of patient selection, indications and contraindications, are paramount to the safety and success of these procedures. The diagnostic and therapeutic potential of these procedures is also facilitated by a thorough evaluation of the spine, with respect to both anatomy and potential pathology, with cross sectional imaging techniques as well as other radiologic tests. Communication of these results between the Radiologist and the spine proceduralist will contribute to optimal patient outcomes.
Case-based Review of Musculoskeletal Radiology (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: S406A

LEARNING OBJECTIVES

1) Identify the application of basic anatomic, pathologic, and physiologic principles to specific disease processes that affect the muscles, shoulder, elbow, wrist and hand. 2) Illustrate using case examples of several important disease processes that affect these regions, using several imaging methods and emphasizing the value of each. 3) Present the major teaching points and differential diagnostic considerations for each of the chosen cases and, when appropriate, clarify the importance of early accurate diagnosis.

ABSTRACT

Accurate diagnosis of many disorders that affect muscles, shoulder, elbow, wrist and hand can be accomplished with basic or advanced imaging methods, or both. A series of cases will be used to illustrate a few of these disorders, with attention to the most appropriate imaging protocol, the salient imaging findings, the anatomic and pathophysiologic factors that explain the findings, and the important differential.

Sub-Events

MSCS51A  Muscle

Participants
Andrew J. Grainger, MRCP, FRCR, Leeds, United Kingdom (Presenter) Speaker, General Electric Company; Equipment support, Siemens AG;

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCS51B  Shoulder

Participants
Jenny T. Bencardino, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Honored Educators

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Jenny T. Bencardino, MD - 2014 Honored Educator

MSCS51C  Elbow

Participants
Kathryn J. Stevens, MD, Menlo Park, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCS51D  Wrist and Hand

Participants
Leon Lenchik, MD, Winston-Salem, NC, (llenchik@wakehealth.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
Participants
Theodore T. Miller, MD, New York, NY (Director) Nothing to Disclose

LEARNING OBJECTIVES
1) Apply the technique for MR imaging of hip and knee replacements. 2) Recognize and describe the MR appearances of complications related to these joint replacements.

ABSTRACT
MR imaging of hip and knee replacements requires adjustment of scanning parameters, such as using fast spin echo sequences with long echo train length, maximum receiver bandwidth, thin slices, and a high frequency-encoding matrix, to minimize intravoxel dephasing and misregistration artifacts. Proprietary techniques such as MAVRIC (multi-acquisition variable resonance image combination) and SEMAC (slice-encoding metal artifact correction) can also reduce metal-related artifacts. Complications encountered on MR imaging of hip and knee replacements will be discussed, including adverse reactions to metal debris, polymeric wear, infection, osteolysis, component loosening, stress reaction and fracture, and tendon tears.

Participants
Felix S. Chew, MD, Seattle, WA, (fchew@uw.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize and describe the features of shoulder joint replacements on radiologic images. 2) Recognize and describe the features of elbow joint replacements on radiologic images.

ABSTRACT
Shoulder joint replacements include anatomic total joint replacements, humeral head replacements, and reverse total joint replacements. Elbow joint replacements include replacements of the radial head alone, replacements of the radiocapitellar compartment, and replacements of the ulno-trochlear compartment. Knowledge of the expected appearances of each type of postsurgical construct and the range of complications will improve the radiologist’s ability to identify complications.

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Felix S. Chew, MD - 2012 Honored Educator

Participants
Laura W. Bancroft, MD, Orlando, FL, (laura.bancroft.md@flhosp.org) (Presenter) Royalties, Wolters Kluwer nv

LEARNING OBJECTIVES
1) Review imaging characteristics of arthroplasties in smaller joints, such as the ankle/foot, hands/feet and elbow. 2) Demonstrate complications of smaller joint arthroplasties with various imaging modalities.

ABSTRACT
This refresher course will encompass the imaging characteristics of arthroplasties in smaller joints, such as the ankle/foot, hands/feet and elbow. The normal appearances and complications of smaller joint arthroplasties will be demonstrated utilizing various imaging modalities.
Vertebral Augmentation (Hands-on)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E260

Participants
A. Orlando Ortiz, MD, MBA, Mineola, NY (Presenter) Nothing to Disclose
Bassem A. Georgy, MD, MSc, San Diego, CA (Presenter) Consultant, Johnson & Johnson; Consultant, DFINE, Inc; Stockholder, DFINE, Inc; Stockholder, Spine Solutions, Inc; ;
Allan L. Brook, MD, Bronx, NY (Presenter) Advisor, Johnson & Johnson Advisor, Medtronic, Inc
Afshin Gangi, MD, PhD, Strasbourg, France (Presenter) Nothing to Disclose
Todd S. Miller, MD, Bronx, NY, (tmiller@montefiore.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss appropriate algorithms for patient selection. 2) Review anatomic and technical considerations for vertebral augmentation.
3) Present an update of the recent advances in vertebral augmentation including sacroplasty. 4) Emphasize safety issues and how to avoid complications. 5) Understand the applications of vertebral augmentation in osteoporotic and neoplastic spine pathology. 6) Update participants with respect to advances in equipment and biomaterials.

ABSTRACT
1. Patient selection for vertebral augmentation. 2. New devices and techniques in vertebral augmentation. 3. Vertebral augmentation for osteoporotic and pathologic vertebral compression fractures. 4. Sacroplasty (sacral augmentation). 5. Complications avoidance. 6. Efficacy. Vertebral augmentation is an image-guided (fluoroscopy or CT) percutaneous procedure in which a bone needle is inserted into a painful osteoporotic or pathologic fracture within the spinal axis. Biopsy, cavity creation or lesion ablation may then be performed under imaging guidance depending on the nature of the pathology that is being treated. Subsequently a radioopaque implant, usually an acrylic bone cement, is carefully injected into the vertebra or sacral ala under imaging guidance. These procedures have been shown to provide pain relief by stabilizing the fractured vertebra or sacrum. As with any other invasive procedure, they carry a small risk (<<1%) of complication including bleeding, infection, neurovascular injury, or cement embolus. Appropriate patient selection and a detailed understanding of the technical aspects of the procedure along with active clinical patient follow-up are paramount to a successful outcome. This workshop will utilize short lectures, case examples and interactive audience participation in order to further explore critical topics in vertebral augmentation.

URL
www.winthropradioogy.com
LEARNING OBJECTIVES

1) Identify the application of basic anatomic, pathologic, and physiologic principles to tumors as well as specific disease processes that affect the knee, hip, ankle and foot. 2) Illustrate using case examples of several important disease processes that are characteristic of the chosen topics, using several imaging methods and emphasizing the value of each. 3) Present the major teaching points and differential diagnostic considerations for each of the chosen cases and, when appropriate, clarify the importance of early accurate diagnosis.

ABSTRACT

Accurate diagnosis of many disorders that affect the knee, hip, ankle and foot as well as musculoskeletal tumors can be accomplished with basic or advanced imaging methods, or both. A series of cases will be used to illustrate a few of these disorders, with attention to the most appropriate imaging protocol, the salient imaging findings, the anatomic and pathophysiologic factors that explain the findings, and the important differential.

Sub-Events

MSCS52A  Tumor

Participants
Mark J. Kransdorf, MD, Phoenix, AZ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

MSCS52B  Ankle and Foot

Participants
Donald L. Resnick, MD, San Diego, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCS52C  Knee

Participants
William E. Palmer, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

MSCS52D  Hip

Participants
Christian W. Pfirrmann, MD, MBA, Forch, Switzerland (Presenter) Advisory Board, Siemens AG; Consultant, Medtronic, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.
Participants

Sub-Events

**MSES52A  Cervical Spine Trauma**

Participants
Peter J. MacMahon, MD, Dublin, Ireland, (pmacmahon@mater.ie) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the stabilizing anatomical structures of the cervical spine. 2) Appraise the indications for the various cervical spine imaging modalities. 3) Classify cervical spinal injuries based on the mechanism of injury and stability. 4) Differentiate the most common cervical spine injuries. 5) Detect subtle soft tissue and bony injuries of the cervical spine.

**MSES52B  A Simplified Approach to Imaging Acetabular Fractures**

Participants
Ustun Aydingoz, MD, Ankara, Turkey, (ustunaydingoz@yahoo.com) (Presenter) Speaker, AbbVie Inc; Spouse, Stockholder, Edita Medical Writing Editing Ltd; Spouse, Employee, Edita Medical Writing Editing Ltd;

**LEARNING OBJECTIVES**

1) Identify the imaginary lines on radiographs to determine the presence of an acetabular fracture. 2) List five most common acetabular fractures that comprise approximately 90% of all. 3) Apply an algorithm to detect the five most common acetabular fractures on radiographs and/or CT. 4) Explain the most relevant information for the clinician regarding imaging assessment of acetabular fractures.

**ABSTRACT**

Imaging plays an indispensable role in detecting and classifying acetabular fractures. This live activity will focus on: A) identifying acetabular fractures on radiographs and CT, B) using an algorithm to classify the five most common acetabular fractures (that comprise approximately 90% of all), and C) mentioning clinically relevant points on imaging reports to help decision-making for better management of the patient's condition.

**MSES52C  Blunt Trauma of Lung, Pleura, Airways, and Chest Wall**

Participants
Guillermo P. Sangster, MD, Shreveport, LA, (gsangs@lsuhsc.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Substantiate the advantages of multidetector computed tomography (MDCT) over Chest x-ray for the initial screening of chest trauma. 2) Identify the MDCT imaging findings of the non-vascular traumatic thoracic injuries.

**ABSTRACT**

Chest radiography has been the traditional screening technique to evaluate traumatic thoracic injuries. The information obtained is usually sub optimal for the diagnosis of non-vascular thoracic injuries. The benefits of MDCT for its diagnosis are discussed in this live activity. Images from our level I trauma center database are shown, including: A) Thoracic wall injuries: diaphragmatic rupture, sternum and scapular fractures, sterno-clavicular dislocation and flail chest. B) Pleuro-pulmonary injuries: contusion, laceration, hemaition, pneumothorax, and hemothorax. C) Intrathoracic traqueo-bronchial laceration.
**Musculoskeletal Thursday Poster Discussions**

Thursday, Dec. 3 12:15PM - 12:45PM Location: MK Community, Learning Center

**MKS-THA**

**Characterization of Deposits in Patients With Calcific Tendinopathy of the Supraspinatus. Role of Phytate and Osteopontin**

**PURPOSE**
Calcific tendinopathy of the tendons of the rotator cuff is common in adults. These calcifications tend to be reabsorbed after a period of acute pain. This study evaluated the morphologic characteristics of calcific deposits and the participation of phytate and osteopontin (OPN) in their development.

**METHOD AND MATERIALS**
Calcific deposits were removed from 21 patients with calcific tendinopathy by ultrasound-guided needle puncture under local anesthesia. The removed deposits were evaluated by scanning electron microscopy, X-ray diffraction and Fourier transform infrared spectroscopy. The amounts of calcium and phosphorus in the deposits were semi-quantitatively determined by energy dispersive X-ray analysis. Phytate was determined in 2 h urine samples, and OPN was extracted from a pool of deposits.

**RESULTS**
The calcific deposits consisted of amorphous and poorly crystalline carbonated hydroxyapatite containing molecular water and organic matter. OPN was associated with the hydroxyapatite deposits. Phytate concentrations were significantly lower in the urine of patients with calcific tendinopathy than in healthy controls. The deficit in crystallization inhibitors such as phytate, and the presence of regulators such as OPN, may play important roles in the development of calcific tendinopathy.

**CONCLUSION**
A deficit in crystallization inhibitors, such as phytate, and the presence of potent regulators such as osteopontin, may be important in the development of calcific tendinopathy.

**CLINICAL RELEVANCE/APPLICATION**
This study was designed to evaluate the morphological characteristics of deposits that develop during calcific tendinopathy (CT) and to determine whether crystallization inhibitors such as phytate and protein regulators such as osteopontin participate in the pathogenesis of CT. Administration of phytate as a natural salt in amounts similar to those in the Mediterranean diet (1-2g phytate/day) did not have any negative effect. Since the development of pathological calcification is a multifactorial process, alterations in only one factor, such as crystallization inhibitors, are generally insufficient to produce calcifications.

**Accuracy of Identification of Anterior Cruciate Ligament Attachments on MRI for Virtual Arthroscopy**

**PURPOSE**
Anatomic anterior cruciate ligament reconstruction (ACLR), currently considered the gold standard treatment for ACL injuries, aims to restore the biomechanics of the knee joint in order to improve patient outcomes and prevent clinical sequelae. However, the optimal placement of femoral and tibial tunnels at the center of native insertion sites can be difficult to determine intraoperatively. We developed a “virtual arthroscopy” tool that utilizes preoperative MRI to generate 3D models that help guide tunnel positioning. We tested the validity of ACL attachment sites located with the model, and determined the accuracy of arthroscopic ACLR guided by our program.

**METHOD AND MATERIALS**
Sixteen adult cadaver knees with intact ACLs were pre-scanned using routine MRI sequences, which were loaded into our MATLAB-based program. A blinded observer identified the ACL footprints on coronal, sagittal, axial views, along with bony contours of the
femur and tibia. Eight knees were opened by an orthopedic surgeon, who marked the center of each attachment site with a screw. In the remaining 8 knees, arthroscopic tunnels were drilled at locations determined from our MRI model. Post-procedural MRI was done on all 16 knees and the attachment sites (now defined by margins of screws or tunnels) were again identified. The 3D distances between pre and postoperative centers of ACL footprints were calculated.

RESULTS
In specimens that underwent an open arthrotomy, the 3D center of the surgically identified femoral and tibial ACL attachments differed by 2.5±0.9mm (mean±SD) and 3.4±1.2mm from attachments identified on preoperative MRI. When MRI landmarks were used to guide arthroscopic ACLR, postoperative femoral and tibial tunnel centers differed by 4.3±2.4mm and 3.1±0.7mm from the preoperative landmarks. When a single outlier was removed, the femoral tunnel center mean dropped to 3.5±1.3mm.

CONCLUSION
MRI "virtual arthroscopy" models reliably locate native ACL attachment sites within approximately 5 mm of surgically identified attachments. ACLR tunnels can be placed at these locations under MRI guidance with similar precision. With further refinement, these models may prove to be a practical and effective tool to assist surgeons performing ACLR.

CLINICAL RELEVANCE/APPLICATION
An MRI-based virtual arthroscopy tool can reliably identify ACL attachments, encouraging future integration into preoperative planning and intraoperative assistance in arthroscopic ACL reconstruction.

MK370-SD-THA3
Optimization of the Time of Spin Lock for the T1rho Relaxation Time in Lumbar Intervertebral Discs

Participants
Rui Imamura, Sapporo, Japan (Presenter) Nothing to Disclose
Hiroaki Takashima, PhD, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Hiroyuki Shishido, RT, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Yoshihiro Akatsuka, RT, Sapporo, Japan (Abstract Co-Author) Nothing to Disclose
Masamitsu Hatakenaka, MD, PhD, Sapporo, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation

PURPOSE
The aim of this prospective study was to evaluate the effects of numbers and patterns of the time of spin lock (TSL) on the T1rho relaxation time in the intervertebral discs.

METHOD AND MATERIALS
The lumbar intervertebral discs of 30 volunteers (22 males, 8 females; age range, 23-57 years) were evaluated by 3.0T MRI (Ingenia, Philips Healthcare). The degree of disc degeneration was assessed in the midsagittal section on T2-weighted images according to the Pfirrmann classification (grades I-V). The T1rho relaxation time calculated using all data (TSL = 1, 5, 10, 20, 40, 60, 80, and 100 ms) was defined as the standard value. We compared the standard value with calculated T1rho relaxation times using undersampling data (nine sampling patterns). The differences between these T1rho relaxation times were then evaluated using Pearson's product-moment correlation coefficients.

RESULTS
According to the T2-weighted image-based Pfirrmann grade classification, grade I consisted of 45 discs, grade II consisted of 66 discs, grade III consisted of 126 discs, and grade IV consisted of 63 discs. A strong correlation was found between the standard value and the calculated T1rho relaxation time using TSLs of 1, 5, 10, 20, and 80 ms (r = 0.96, p < 0.01). However, the three-TSL (1, 20, and 60 ms) pattern showed a poor correlation with the standard value (r = 0.47).

CONCLUSION
To accurately assess the T1rho relaxation time, it is necessary to include a short TSL (< 20 ms) and at least five or more TSLs.

CLINICAL RELEVANCE/APPLICATION
With optimized TSL sampling, it is possible to more accurately assess the T1rho relaxation time in degenerated intervertebral discs.

MK371-SD-THA4
Rotator Cuff Tear Shape Characterization: A Comparison of 2D Imaging and 3D MR Reconstructions

Participants
Soterios Gyftopoulos, MD, New York, NY (Presenter) Nothing to Disclose
Luis S. Beltran, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Kevin P. Gibbs, MD, Charleston, SC (Abstract Co-Author) Nothing to Disclose
Philip M. Berman, BA, New York, NY (Abstract Co-Author) Nothing to Disclose
James S. Babb, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Robert Meislin, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
To see if 3D MR imaging could improve our understanding of rotator cuff tendon tear shapes. We believed that 3D MR imaging would be more accurate than current 2D MR imaging for classifying tear shapes.

METHOD AND MATERIALS
We performed a retrospective review of MR examinations of patients with arthroscopically proven full thickness rotator cuff tears. Two orthopaedic surgeons reviewed the information for each case, including scope images, and characterized the shape of the cuff tear into: crescent, longitudinal, U/L shaped longitudinal, and massive type. Two musculoskeletal radiologists reviewed the
corresponding MRIs independently and blind to the arthroscopic findings, and characterized the shape based on the tear’s retraction and size using 2D MRI. 3D reconstructions of each rotator cuff tear were then reviewed by each radiologist, blindly and independently, to characterize the shape. The 3D reconstructions were created through manual segmentation using post-processing software. The average time for creation of each reconstruction was 2-3 minutes. Statistical analysis included 95% confidence intervals and intra-class correlation coefficients.

RESULTS
34 patients were reviewed. The accuracy for differentiating between crescent shaped, longitudinal, and massive tears using 2D MRI for reader #1 was 70.6% and 67.6% for reader #2. The accuracy for tear shape characterization into crescent and longitudinal U or L shaped using 3D MRI for reader #1 was 97.1% and 82.4% for reader #2. When further characterizing the longitudinal tears as massive or not, both readers had an accuracy of 76.9% (10/13). The overall accuracy of the 3D MRI reconstructions, including both readers, was 82.4% (56/68), significantly different (p=0.021) from 2D MRI accuracy (64.7%).

CONCLUSION
Our study has demonstrated that 3D MR reconstructions of the rotator cuff improve the accuracy of characterizing rotator cuff tear shapes compared to current 2D MRI based techniques.

CLINICAL RELEVANCE/APPLICATION
The findings in our study suggest that 3D imaging of the rotator cuff may serve as an important tool in the future for better characterizing and understanding rotator cuff tears, and providing important information for surgical planning.

MK372-SD-THA5 Primary OsteoArthritis of the Hip in Young People: Benefits of Ultrasound Guided Injection of PRP vs Hyaluronic Acid

Station #5

Participants
Andrea Mancini, MD, Laquila, Italy (Presenter) Nothing to Disclose
Alice La Marra, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Arrigoni, Coppito, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Mariani, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To propose an effective treatment in young people with premature primary osteoarthritis of the hip.

METHOD AND MATERIALS
From January 2013 to January 2015, we enrolled 45 patients (25 M, 20 F), with symptomatic monolateral OA of the hip; 25 treated with PRP (group 1) and 20 treated with HA (group 2). Inclusion criteria were: age between 30-45 (avg 38.6); grade 1 or 2 of an adapted scale of Kallgren and Lawrence; grade 1-3, according the gradations of severity in an MRI scale; Visual Analogic Scale 7-10 (group 1 = avg 8.3, group 2 = avg 8.1); Harris Hip Score 60-70 (group 1 = avg 62, group 2 = avg 66). We excluded patients with secondary OA (for example post-traumatic or immunologic disorders related). In both groups we started our treatment with an intrarticular steroids injection; after 2 weeks we performed three injection of PRP or of HA at the distance of 2 weeks from each other. We performed an MRI 6 months after the last PRP or HA treatment.

RESULTS
Benefits were evaluated after 6 months in terms of: Group 1: pain relief with VAS = improved of 75.9% (VAS 1-3 avg 2.0); HHS = improved of 41.61% (HHS 75-95 avg 87.8); MR findings = we obtained an improvement in : synovitis (25 out of 25), subcondral signal of femoral head (18 of 25) , T2WI of the articular cartilage (14 out of 25). Group 2: pain relief with VAS = improved of 70.37% (VAS 1-3 avg 2.4); HHS = improved of 21.21% (HHS 75-95 avg 80); MR findings = we obtained an improvement in : synovitis (20 out of 20), subcondral signal of femoral head (10 out of 25) , T2WI of the articular cartilage (2 out of 20).

CONCLUSION
Our study showed that the US-guided intra-articular injection of PRP is a good solution for primary OA of the hip, especially for young people in comparison with HA treatment.

CLINICAL RELEVANCE/APPLICATION
Our study is very important in order to offer a minimally invasive and effective treatment in young patients with painful osteoarthritis of the hip.

MK373-SD-THA6 Comparison of Conventional MR Findings and ADC Values in Differential Diagnosis of Benign and Malignant Soft Tissue Tumors

Station #6

Participants
Young Cheol Yoon, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Yoonah Song, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yousun Chong, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
To compare the diagnostic performance of conventional MR findings and ADC values for differentiating benign and malignant soft tissue tumors.

METHOD AND MATERIALS
123 patients (90 male and 33 female; 67 of myxoid and 56 non-myxoid) undergoing MR including ADC...
123 patients (70 malignant and 53 benign STTs; 72 of myxoid and 51 non-myxoid) who underwent pre-operative MR including ADC map were enrolled. Two MSK radiologists analyzed conventional MR findings by a consensus: maximum diameter, deep compartment involvement, central necrosis, signal heterogeneity in T1W image. These two readers measured mean and minimum ADC values of STTs independently. Statistical analyses were done; to evaluate the difference of frequency of each parameter; to determine the cut-off values of ADC values and maximum diameter for calculating sensitivity/specificity/accuracy/AUC; to calculate the OR; to compare the size of AUC of each parameter. The same analyses were performed in subgroup of non-myxoid STTs.

RESULTS

There were significant differences of frequency of conventional MR findings and mean and minimum ADC values except deep compartment involvement between benign and malignant STTs. The order of AUC and OR was maximum diameter (AUC/OR, 0.73/9.29; cut-off value of 31.5 mm), mean ADC (AUC/OR, 0.70/5.68; cut-off value of 805.4 mm2/sec), maximum diameter (AUC/OR, 0.68/4.33; cut-off value of 1348.15 mm2/sec), T1 heterogeneity (AUC/OR, 0.65/3.58), and central necrosis (AUC/OR, 0.59/3.56). The AUC of maximum diameter was significantly larger than that of central necrosis (p<0.0140). Regarding the subgroup analysis of non-myxoid STTs, mean ADC, min ADC, and T1 heterogeneity showed significant differences between benign and malignant STTs. The order of AUC and OR was mean ADC (AUC/OR, 0.83/21.25; cut-off value of 1132.45 mm2/sec), min ADC (AUC/OR, 0.78/10.51; cut-off value of 630.75 mm2/sec) and T1 heterogeneity (AUC/OR, 0.63/4.38). The AUC of mean ADC was larger than that of T1 heterogeneity (p<0.0470). There were no significant differences of AUC between mean ADC and min ADC.

CONCLUSION

Conventional imaging findings including maximum diameter, signal heterogeneity on T1W image, presence of central necrosis, and ADC values were useful to differentiate benign and malignant STTs. ADC values and signal heterogeneity on T1W image were much powerful tools to differentiate benign and malignant non-myxoid STTs.

CLINICAL RELEVANCE/APPLICATION

ADC values of DW images are much helpful parameters in differentiation of non-myxoid benign and malignant soft tissue tumors.

MK138-ED-TH7

Superficial Soft Tissue Lesions: Imaging Findings and Systematic Approach

Station #7

Participants

Leonor G. Savarese, MD, Ribeirao Preto, Brazil (Presenter) Nothing to Disclose
Mateus A. Hernandez, MD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose
Marcelo N. Simao, MD, PhD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Mauricio E. Yamashita, MD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Nelson F. Gava, MD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Edgar E. Engel, MD, PhD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Marcelo H. Nogueira-Barbosa, MD, PhD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Marcelo N. Simao, MD, PhD, Ribeirao Preto, Brazil (Abstract Co-Author) Nothing to Disclose
Mateus A. Hernandez, MD, Chapel Hill, NC (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. To describe the imaging findings of common superficial soft-tissue lesions, with radiologic-pathologic correlation.
2. To illustrate a systematic approach to narrow the differential diagnosis of superficial soft-tissue lesions.

TABLE OF CONTENTS/OUTLINE

Superficial soft-tissue lesions are frequently encountered by radiologists in everyday clinical practice. Imaging findings of some lesions, such as lipomas, usually enable a definitive diagnosis. However, the imaging features of many superficial soft-tissue lesions may be nonspecific. We illustrate lesions of different etiologies according to their commonest anatomical sites, such as cutaneous tissue (e.g., epidermal cyst, pilomatrixoma, dermatofibrosarcoma protubersans), subcutaneous adipose tissue (e.g., benign nerve sheath tumor), and fascia overlying the muscle (e.g., nodular fasciitis). In addition to location, by systematically using the lesion imaging findings and clinical history, the radiologist may narrow the differential diagnosis for lesions with indeterminate characteristics, or achieve a definitive diagnosis for lesions that have characteristic features. This exhibit will provide a comprehensive imaging review and a systematic diagnostic approach to help the radiologist develop an appropriate differential diagnosis list.

MK184-ED-TH8

Avulsion Fractures around the Foot and Ankle: Where Did I Come from and Why Am I Here?

Station #8

Participants

Kuan-Ching Ho, MD, FRANZCR, Ottawa, ON (Presenter) Nothing to Disclose
Kawan S. Rakha, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Marcos L. Sampaio, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Ryan C. Foster, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Zaid Jibi, MBChB, Ottawa, ON (Abstract Co-Author) Nothing to Disclose
Adnan M. Sheikh, MD, Ottawa, ON (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

1. Illustrate the mechanism of injury of the avulsion fractures around the ankle and foot.
2. Describe the imaging findings of these injuries, thereby facilitating timely diagnosis and treatment of these relatively less common injuries.

TABLE OF CONTENTS/OUTLINE

The cases will be presented in a quiz format. Pertinent anatomy and imaging findings (radiograph, US and MRI) of each case will be discussed. Avulsion fractures along the medial, lateral, posterior and anterior, ankle and foot will be presented.

MK230-ED-TH9

Systematized Approach for the Evaluation of the Spinal Column Degenerative Disease

Station #9

Participants
TEACHING POINTS
- To recognize characteristic imaging findings of the normal degenerative changes of the spine.
- To describe a systemized approach for evaluating spinal column degenerative disease (SCDD).
- To identify appropriate uses of imaging methods for evaluating SCDD.
- To list the essential imaging features of the main degenerative spinal changes.
- To keep in mind the major differential diagnosis of SCDD.

TABLE OF CONTENTS/OUTLINE
The Feasibility of Dual-Energy CT Detection of Vertebral Compression Fractures

PURPOSE
To prospectively evaluate the ability of dual-energy computed tomography, compared with magnetic resonance imaging, to identify vertebral compression fractures in acute trauma patients.

METHOD AND MATERIALS
This institutional review board-approved study included 23 consecutive patients with 32 vertebral fractures who underwent both dual-energy computed tomography and magnetic resonance imaging of the spine between February 2014 and September 2014. A total of 209 vertebrae were evaluated for the presence of abnormal bone marrow attenuation on dual-energy computed tomography and signal on magnetic resonance imaging by five experienced radiologists. The specificity, sensitivity, predictive values, and intra- and inter-observer agreements were calculated.

RESULTS
MRI revealed a total of 47 vertebrae (22.4% of all vertebrae) and dual-energy computed tomography revealed 44 vertebrae (21% of all vertebrae) with edema. Using MRI as the reference standard, dual-energy computed tomography had a sensitivity, specificity, positive predictive value, negative predictive value and accuracy for the detection of vertebral edema 89.3%, 98.7%, 95.4%, 96.9%, and 96.6 %, respectively. With respect to establishing the presence of edema, the inter-observer agreement was almost perfect (k = 0.82), and the intra-observer agreement was substantial (k = 0.80).

CONCLUSION
Compared with magnetic resonance imaging, dual-energy computed tomography can provide an accurate demonstration of acute vertebral fractures and can be used as an alternative imaging modality for the assessment of vertebra fractures in patients with contraindications for magnetic resonance imaging.

CLINICAL RELEVANCE/APPLICATION
DSCT scanning can be used routinely in the clinic as an alternative imaging modality for the assessment of vertebral fractures in patients with contraindications for MRI.

Ultra Low Dose CT Scans for Fracture Evaluation: A Reliable and Effective Modality with an Improved Patient Safety Profile

PURPOSE
This study aims to evaluate whether an ultra low dose CT scan (ULD-CT) is sufficient to detect, diagnose, and guide treatment for various fracture types as compared to conventional CT imaging (C-CT).

METHOD AND MATERIALS
An ULD-CT protocol was developed as a quality improvement/patient safety measure at our academic medical center. This protocol was applied to 50 consecutive patients. A representative sample of cases were extracted and compared to cases matched for injury, age and sex in a cohort of patients who had undergone C-CT scanning previously. Estimated effective dose was calculated for all ULD-CT and C-CT scans chosen comprising 32 total studies of the extremities. Images from each study were selected, de-
identified, and grouped into one set that was reviewed by nine fellowship trained orthopaedic traumatologists and 1 chief orthopaedic resident, from 5 academic level I trauma centers. The set of images consisted of a series of key cuts of 8 different fracture types in 5 anatomic locations (5 foot, 3 knee, 3 ankle, 3 elbow, and 2 hip fracture). Each evaluator individually reviewed the image set two times at a minimum of 4 weeks apart, to allow for adequate washout. Outcome measures included correct diagnosis, management plan, weight bearing status (WBS) and adequacy of image quality.

RESULTS
Mean estimated effective dose (ED) for ULD-CT vs. C-CT was 0.03 mSv vs. 0.43 mSv (p<0.05). The Sn, Sp, PPV, and NPV of ULD-CT to detect all fractures was 0.86, 0.80, 0.98, and 0.36, but increased to 0.98, 0.80, 0.98, and 0.80 with occult fractures excluded. Interobserver and intraobserver reliability for diagnosis utilizing ULD-CT (κ=.75, κ=.67) yielded substantial agreement among observers, similar to C-CT (κ=.85, κ=.82). Interobserver agreement for treatment, treatment modality, WBS, and study quality utilizing ULD-CT was moderate to near perfect (κ=.67, κ=.67, κ=.56, κ=.81) versus C-CT (κ=.84, κ=.84, κ=.78, κ=.86).

CONCLUSION
A mean estimated ED of .03 mSv was achieved with ULD-CT, a 14x reduction as compared to C-CT. Reliability statistics between ULD-CT and C-CT were comparable across images indicating that ULD-CT could be readily interpreted by orthopaedic traumatologists.

CLINICAL RELEVANCE/APPLICATION
This ULD-CT protocol appears to provide for high fidelity images in appropriately selected patients. Dose reduction strategies as demonstrated here may help to address public concerns over radiation exposure.

Participants
Amy L. Ellenbogen, MD, Washington, DC (Presenter) Nothing to Disclose
Pranav K. Vyas, MD, Washington, DC (Abstract Co-Author) Nothing to Disclose

PURPOSE
We hope to contribute to the existing literature on the accuracy of the Ottawa Ankle Rules (OAR) in the pediatric population in order to minimize unnecessary radiation exposure as well as decrease healthcare costs and Emergency Room wait times. Our study differs from previous literature in that it is retrospective in nature and has a larger sample size than previous studies but lacks the disadvantages inherent in a meta-analysis.

METHOD AND MATERIALS
We conducted a retrospective chart review consisting of children with the ability to walk through eighteen years of age. We first used a radiology search engine to find all ankle X-rays obtained at our institution's Emergency Room and that of an associated institution between 1/1/2011 and 4/30/2014. We recorded whether a fracture was identified on the X-ray read and if so, what type of fracture. If the read was indeterminate, the subject was excluded. We then used our hospital's electronic medical record to access the Emergency Room provider's note to determine whether the patient met criteria for X-ray based on the Ottawa Ankle Rules and if so, which criteria were met. The subject was excluded if the provider did not document sufficient exam data to determine whether criteria were met. Patients with underlying diseases that could predispose them to fracture were excluded.

RESULTS
A total of 1050 subjects met inclusion criteria. The mean age was 11.6 years with ages ranging from fourteen months to eighteen years. One hundred and thirteen fractures were identified (11%), seventy-eight of which were significant. Sensitivity was 63%, specificity 82%, positive predictive value 25%, and negative predictive value 94%.

CONCLUSION
Our results show a lower sensitivity and higher specificity than previous studies on the Ottawa Ankle Rules (OAR) in the pediatric population. Our study differs in that we have a larger sample size than previous studies. We conducted a retrospective study, whereas most of the previously published literature is prospective, however we were careful to exclude all subjects where documentation was insufficient to determine whether the patient met the OAR.

CLINICAL RELEVANCE/APPLICATION
Our study aims to reduce unnecessary radiation exposure in children, decrease healthcare costs, and possibly decrease wait times in pediatric Emergency Rooms.

Participants
Xue S. Bai, MD, Seattle, WA (Presenter) Nothing to Disclose
Jonelle M. Petscavage-Thomas, MD, MPH, Hummelstown, PA (Abstract Co-Author) Consultant, Medical Metrics, Inc
Alice S. Ha, MD, Seattle, WA (Abstract Co-Author) Grant, General Electric Company

PURPOSE
Total elbow arthroplasty (TEA) is becoming a more popular alternative to arthrodesis for patients with end-stage elbow arthrosis in an attempt to decrease pain and restore function of the elbow joint. Prior outcome studies have primarily focused on surgical findings. Our purpose is to determine the radiographic outcome of TEA and to correlate it with clinical outcome.

METHOD AND MATERIALS
In a 10-year retrospective review of patients with TEA (semiconstrained type), all available elbow radiographs and clinical data were reviewed. The purpose of the study was to determine the radiographic outcome of TEA and to correlate it with clinical outcome.
in a 10-year retrospective review of patients with TKA (semiconstrained type), all available elbow radiographs and clinical data were reviewed. Data analysis included descriptive statistics, Fischer's exact test, and Kaplan-Meier survival curves for radiographic and clinical survival.

RESULTS

59 total elbow arthroplasties in 55 patients were reviewed. 74% were in women, and the mean patient age was 62.4 years. Mean radiographic follow-up was 1.9 years with an average of 3.3 radiographs per patient. 40 patients (67%) developed one or more radiographic complications, including periprosthetic lucency (44%), periprosthetic fracture (43%), periprosthetic lucency (43%), and brushing wear down/particle disease (10%). 17 patients (31%) developed significant pain and 18 patients (33%) underwent at least one reoperation. In patients with radiographic complications, 49% of them had significant pain compared with 13% without radiographic complication, which was statistically significant (p = 0.008). Of the patients with radiographic complications, 37% had to undergo at least 1 revision surgery compared to 25% without radiographic complication, not statistically significant (p=0.2555).

CONCLUSION

Radiographic complications are common after total elbow arthroplasty. There is a strong positive correlation between postoperative radiographic findings and clinical outcome.

CLINICAL RELEVANCE/APPLICATION

Total elbow arthroplasty is becoming a popular option for patients with end stage arthrosis. Therefore, knowledge of common postoperative radiographic findings and the clinical significance of those findings are important for the radiologist.

MK378-SD-THB5 Loaded versus Unloaded Magnetic Resonance Imaging (MRI) of the Knee: Effect on Meniscus Extrusion in Healthy Volunteers and Patients with Osteoarthritis

Station #5

Participants
Rina Patel, MD, San Francisco, CA (Presenter) Nothing to Disclose
Daria Motamedi, MD, Washington DC, DC (Abstract Co-Author) Nothing to Disclose
Matthew Elgrotz, MD, San Bruno, CA (Abstract Co-Author) Nothing to Disclose
Richard B. Souza, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Sharmila Majumdar, PhD, San Francisco, CA (Abstract Co-Author) Research Grant, General Electric Company
Thomas M. Link, MD, PhD, San Francisco, CA (Abstract Co-Author) Research funded, General Electric Company; Research funded, InSightec Ltd; Royalties, Springer Science+Business Media Deutschland GmbH; Research Consultant, Pfizer Inc;

PURPOSE

The purpose of this study was to assess the impact of axial knee joint loading on meniscal extrusion in normal individuals and those with varying degrees of osteoarthritis (OA).

METHOD AND MATERIALS

157 healthy volunteers and patients with OA underwent 3 Tesla MRI of the knee under unloaded and loaded conditions. Loaded MRI was performed with an axial loading device at 50% body weight. Meniscal extrusion was defined as the distance from the peripheral margin of the medial tibial plateau to the peripheral margin of the meniscus, measured on the coronal sequence at the mid-point of the femoral condyle. Kellgren-Lawrence (KL) grading system was used to grade OA. The mean and standard deviation measurements for medial and lateral meniscus extrusion in unloaded and loaded conditions, as well as the mean and standard deviation of the difference were calculated. Statistical analysis with a paired T-test was performed for each KL group. Statistical significance was defined for all calculations as p<0.05.

RESULTS

The cohort included 97 women and 60 men with an average age of 53 years +/- 10 years (range 35 to 73 years). Kellgren-Lawrence grade distribution was as follows: 60 with grade 0, 50 with grade 1, 26 with grade 2, 18 with grade 3, and 3 with grade 4. In a 10-year retrospective review of patients with TEA (semiconstrained type), all available elbow radiographs and clinical data were reviewed. Data analysis included descriptive statistics, Fischer's exact test, and Kaplan-Meier survival curves for radiographic and clinical survival.

CONCLUSION

Prior studies have suggested that meniscal extrusion or altered meniscal function may precede osteoarthritic progression. Our study demonstrated that meniscal extrusion significantly increased during loading and with KL grade; differences between KL grades were most significant during loading. Interestingly, at the lateral meniscus no such relationship was found.

CLINICAL RELEVANCE/APPLICATION

Our study shows that loaded MRI may more accurately determine the extent of meniscal extrusion in particular in those with OA.

MK379-SD-THB6 Does CT Imaging have the Ability to Identify the Dedifferentiated Component (DDLPS) in a Retroperitoneal Well Differentiated Liposarcoma (WDLPS)?

Station #6

Participants
Priya R. Bhosale, MD, Houston, TX (Presenter) Nothing to Disclose
Jieqi Wang, BA, Houston, TX (Abstract Co-Author) Nothing to Disclose
Datla G. Varma, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Corey T. Jensen, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Tara L. Sagebiel, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Madhavi Patnana, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
PURPOSE
To evaluate the CT imaging features which may predict the presence of a DDLPS component within a retroperitoneal WDLPS.

METHOD AND MATERIALS
49 treatment naive patients with WDLPS (12) or DDLPS (37) who underwent computed tomography (CT) were included in the study following approval of the institutional review board. Three Radiologists evaluated the studies independently in a blinded fashion on a diagnostic workstation for < or >25% fat, presence of a ground glass nodule (a nodule having as attenuation lower than adjacent psoas muscle and hazy internal architecture), enhancing nodule (higher attenuation than psoas muscle), necrotic nodule (enhancing nodule with central areas of low attenuation), capsule surrounding the mass, septations, calcification (popcorn, spiculated or curvilinear), and final diagnosis of WDLPS or DDLPS. Statistical analysis was performed using multivariate logistic regression model with generalized estimating equations (GEE) method was used to correlate imaging features with pathology. $P$-values of 0.05 or less were considered statistically significant. Kappa Statistics were performed to assess agreement of the 5 features by all the three radiologists.

RESULTS
The accuracy, sensitivity, specificity, positive predictive value and negative predictive values to diagnose the DDLPS in the WDLPS were 75.5%, 91.7%, 70.2%, 50.0% and 96.3%, 79.6%, 91.7%, 75.7%, 55.0% and 96.5% and 73.3%, 91.7%, 67.6%, 47.8% and 96.5% for reader 1, 2 and 3. All three readers showed almost perfect agreement in overall diagnosis based on Kappa statistics (95% confidence interval $r = 0.83$ (0.63 to 0.99)). The presence of an enhancing nodule was highly suggestive of DDLPS ($P < 0.02$).

CONCLUSION
The presence of an enhancing nodule is highly specific for the diagnosis of DDLPS component in a retroperitoneal WDLPS.

CLINICAL RELEVANCE/APPLICATION
Imaging may help guide appropriate biopsy of the dedifferentiated component within a well differentiative liposarcoma which can further help streamline patient management.

Honored Educators
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Priya R. Bhosale, MD - 2012 Honored Educator

MK139-ED-THB7 Imaging of Congenital and Pathologic Diseases of the Ribs

Participants
Maxine E. Darke, MD, Columbia, MO (Abstract Co-Author) Nothing to Disclose
Iclal Ocak, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Cynthia A. Britton, MD, Pittsburgh, PA (Presenter) Nothing to Disclose

TEACHING POINTS
1. Emphasize the importance of careful examination of the ribs as an integral component of both the chest radiographic and CT examination and present an algorithm for interpretation.
2. Provide key examples of congenital and pathologic diseases of the ribs, whether unique to the ribs themselves or as a component of a more diffuse disease or syndrome.

TABLE OF CONTENTS.OUTLINE
Provide an algorithm for examination of the ribs in addition to illustrating the following categories of rib abnormalities:
1. Congenital diseases including cervical ribs, Sprengel's deformity, congenital rib fusion, duplicate ribs and pectus excavatum.
2. Primary malignancies (enchondroma, osteochondroma, fibrous dysplasia) as well as metastatic disease and post-radiation changes in the rib.
3. Metabolic diseases which may affect the ribs including hypertrophic pulmonary osteoarthropathy, sickle cell disease and brown tumor associated with primary hyperparathyroidism.
4. Syndromes such as Proteus syndrome, Englemann's disease, myositis ossificans, SAPHO and POEMS syndromes.

MK187-ED-THB8 A Question of Y: Where the Sternum Meets the Clavicles

Participants
Phey M. Yeap, MBChB, FRCR, Dundee, United Kingdom (Presenter) Nothing to Disclose
Matthew J. Budak, MD, FRCR, Edmonton, AB (Abstract Co-Author) Nothing to Disclose
Jonathan Weir-McCall, MBChB, FRCR, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
David Scott, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose
Barry Oliver, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
The sternoclavicular joint forms the only synovial articulation between the upper limb and the axial skeleton. Disease related to the sternoclavicular joint commonly manifests as non-specific joint pain and swelling. Substantive diagnosis usually necessitates appropriate imaging work up, and possibly biopsy for histopathology assessment. The aims of this exhibit are: 1. To illustrate the normal anatomy and common variants of the sternoclavicular joint. 2. To describe various disorders of the sternoclavicular joint. 3. To demonstrate characteristic and key imaging findings of these disorders on radiographs, CT and MR.

TABLE OF CONTENTS.OUTLINE

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Jeffrey J. Peterson, MD - 2012 Honored Educator

MK234-ED-THB9  **Assessment Bone Marrow Using Advanced MRI Techniques**

Station #9

Participants
Flavia M. Costa, MD, Rio De Janeiro, Brazil (Presenter) Nothing to Disclose
Clarissa Canella, MD, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Augusto G. Altoe, Rio de Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Silvana M. Mendonca, Rio De Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Thomas M. Doring, PhD, Rio De Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose
Bruno Baptista H. Mendes SR, MD, Rio De Janeiro, Brazil (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS

- Advanced MRI techniques, could provide some information, in detecting bone marrow disorders, which is not possible to obtain with conventional images. DWI whole-body imaging can be used to detect and to follow-up treatment response in some bone marrow disease (ex: Myeloma Multiple, Lymphoma, Bone metastasis), which affect management and prognosis of these patients.
- The purpose is to illustrate imaging findings, of bone marrow disorders using advanced MRI techniques (in and out phase sequence, DWI, perfusion and whole-body imaging).
- To correlate advanced MRI with MR conventional images, CT, PET-CT and histopathologic findings.
- To illustrate the differential diagnosis of these pathologies.
- The usefulness of these method in follow-up treatment management (ex: Lymphoma, Multiple Myeloma).

TABLE OF CONTENTS/OUTLINE

- To explain and illustrate the normal marrow distribution and normal variants.
- To illustrate with advanced MRI techniques (in and out phase, DWI, perfusion, Whole body imaging with DWI) the different pathologies that affect bone marrow: 1. Neoplasia (Hematological bone marrow malignancies, Bone metastases and Multiple myeloma); 2. Benign process (Anemias, osteonecrosis, osseous infarct, non-infective inflammatory disease, trauma and infective inflammatory disease).
Sub-Events

SPSH51A  MSK Applications of Dual Energy CT: Gout

Participants
Jeffrey J. Peterson, MD, Neptune Beach, FL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the basic theory and technique of dual energy CT for detection and localization of uric acid. 2) Highlight the current role for DECT in the current clinical algorithm for the diagnosis of gout. 3) Identify the value of DECT 3D tophus quantification in the management of gout.

ABSTRACT
URL

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jeffrey J. Peterson, MD - 2012 Honored Educator

SPSH51B  MSK Applications of Dual Energy CT: Metal Artifact Reduction, Bone Marrow Edema and Tendon/Ligament Analysis

Participants
Savvas Nicolaou, MD, Vancouver, BC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Briefly review the basic physics principles of DECT/Spectral imaging. 2) Explain the clinical utility of DECT in MSK Applications, with a focus on metal artifact reduction, bone marrow edema and tendon/ligament analysis.
**MUSCULOSKELETAL TUMORS**

**Thursday, Dec. 3 4:30PM - 6:00PM Location: S406B**

**AMA PRA Category 1 Credits ™: 1.50**
**ARRT Category A+ Credits: 1.50**

### Participants
Mark D. Murphey, MD, Reston, VA, (MMurphey@acr.org) (Director) Nothing to Disclose

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Mark D. Murphey, MD - 2015 Honored Educator

### Sub-Events

#### RC704A  **Staging of Musculoskeletal Tumors**

### ABSTRACT

**LEARNING OBJECTIVES**
1) Describe the rationale and systems for staging musculoskeletal tumors. 2) List the components of local staging of musculoskeletal tumors at MRI. 3) Identify various MRI pitfalls in staging musculoskeletal tumors.

### RC704B  **Dilemmas and Pitfalls in MSK Tumor Imaging**

### ABSTRACT

**LEARNING OBJECTIVES**
1) Recognize the imaging differentiation of cystic lesions from myxoid neoplasms. 2) Understand the imaging appearance that allows distinction of hematoma from hemorrhagic neoplasm. 3) Identify the imaging characteristic of myositis ossificans. 4) Improve recognition of the concept of impending pathologic fracture and its clinical relevance.

### RC704C  **Post-Treatment Imaging of MSK Tumors**

### ABSTRACT

**LEARNING OBJECTIVES**
1) Construct a framework for evaluation of patients following treatment. 2) Recognize the spectrum of post treatment imaging findings. 3) Identify features to distinguish post treatment change from recurrent tumor.

### RC704D  **Radiologic Treatment of MSK Tumors**

### ABSTRACT

**LEARNING OBJECTIVES**
1) Familiarize the attendee with the most commonly used imaging guided per cutaneous thermal ablation techniques used in treatment of both benign tumours and metastatic disease involving the MSK system. 2) Review indications for radiologic treatment of bone tumors. 3) Examine the potential complications that can be encountered.
**LEARNING OBJECTIVES**

1. Recognize the various types of orthopedic hardware in musculoskeletal imaging practice.
2. Understand the functionality of orthopedic hardware.
3. Identify the adequate positioning of hardware.

**ABSTRACT**

Radiologists are routinely faced with images containing orthopedic hardware. Appropriate recognition of various types of hardware is crucial for the continuation of patient care. The lecture will explain the functionality of orthopedic hardware. Illustrations of the appearance of orthopedic hardware will be made with cartoons, radiographs and Computed Tomography (CT). The attendee will be educated about identification of type of hardware; adequacy of hardware and emphasis will also be placed on diagnosis, complications and malposition of common orthopedic hardware. Guidance will also be provided with regard to appropriate report formulation.

**Guidance**

Treating trauma patients with displaced pelvic fractures requires a multidisciplinary approach at a designated trauma center to
reduce morbidity and mortality. Immediate recognition of pelvic ring disruption and determination of pelvic stability are critical components in the evaluation of such patients. Stability is achieved by the ability of the osseoligamentous structures of the pelvis to withstand physiologic stresses without abnormal deformation. The supporting pelvic ligaments, including the posterior and anterior sacroiliac, iliolumbar, sacrospinous, and sacrotuberous ligaments, play a crucial role in pelvic stabilization. Radiologists should be familiar with the ligamentous anatomy and biomechanics relevant to understanding pelvic ring disruptions, as well as the Young and Burgess classification system, a systematic approach for interpreting pelvic ring disruptions and assessing stability on the basis of fundamental force vectors that create predictable patterns. This system provides an algorithmic approach to interpreting images and categorizes injuries as anterioposterior (AP) compression, lateral compression, vertical shear, or combined. Opening and closing of the pelvis from rotational forces result in AP compression and lateral compression injuries, respectively, whereas vertical shear injuries result from cephalad displacement of the hemipelvis. AP and lateral compression fractures are divided into types 1, 2, and 3, with increasing degrees of severity. Knowledge of these injury patterns leads to prompt identification and diagnosis of other subtle injuries and associated complications at pelvic radiography and cross-sectional imaging, allowing the orthopedic surgeon to apply corrective forces for prompt pelvic stabilization.

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Bharti Khurana, MD - 2014 Honored Educator
Participants
Douglas W. Goodwin, MD, Lebanon, NH, (douglas.goodwin@hitchcock.org) (Moderator) Nothing to Disclose
Jenny T. Bencardino, MD, New York, NY (Moderator) Nothing to Disclose

ABSTRACT
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Jenny T. Bencardino, MD - 2014 Honored Educator

LEARNING OBJECTIVES
1) Recognize a series of pitfalls encountered in shoulder MRI, including variations in normal anatomy and subtle frequently overlooked injuries and abnormalities. 2) Understand how imaging parameters can be manipulated to account for the inherent challenges of shoulder MR imaging. 3) Improve performance by adjusting patterns of image review.

Participants
Laurence D. Stillwater, MD, Winnipeg, MB (Presenter) Nothing to Disclose
James K. Koenig, MD, Winnipeg, MB (Abstract Co-Author) Nothing to Disclose
Bruce W. Maycher, MD, Winnipeg, MB (Abstract Co-Author) Nothing to Disclose
James M. Davidson, MD, Winnipeg, MB (Abstract Co-Author) Nothing to Disclose

PURPOSE
To determine if 3DMR osseous reformats of the shoulder are equivalent to 3DCT osseous reformats in patients with glenohumeral instability.

METHOD AND MATERIALS
Patients with glenohumeral instability, who were to be imaged with both CT and MRI, were prospectively selected. CT and 3TMR were performed within 24 hours of one another on 10 shoulders. Each MR study included an axial 3D isotropic VIBE sequence (acquisition time 4 minutes 15 seconds). The image data from the isotropic VIBE sequence was post processed using subtraction and 3D software. CT data was post processed using 3D software. The following measurements were obtained for both 3DCT and 3DMR post processed images: height and width of the humeral head and glenoid, Hill-Sachs size and percent humeral head loss (if present), Bankart size and percent glenoid bone loss (if present).

RESULTS
The measurement differences from the 3DCT and 3DMR post processed images were not statistically significant: humeral height p=0.06, 95% CI [-0.03, 0.99], humeral width p=0.13, 95% CI [-0.14, 0.90], Hill-Sachs size p=0.42, 95% CI [-0.17, 0.37], percent humeral head loss p=0.93, 95% CI [-0.49, 0.53], glenoid width p=0.13, 95% CI [-0.01, 0.64], Bankart size p=0.43, 95% CI [-0.22, 0.42] and percent glenoid bone loss p=0.22, 95% CI [-0.52, 1.68]. The measurement difference for glenoid height was borderline, p=0.04, 95% CI [0.01, 0.43], however using any adjustment for multiple comparisons this failed to be significant. Using an equivalence margin of 1 mm for measurements and 1.5% for percent bone loss, the 3DMR and 3DCT post processed images were equivalent.

CONCLUSION
3DMR osseous models of the shoulder using a 3D isotropic VIBE sequence were equivalent to 3DCT osseous models and the differences between modalities were not statistically significant. This sequence can be added to MR examinations with only a minimal increase in imaging time and can be used to quantify humeral head and glenoid bone loss. This may eliminate the need for pre-surgical CT examinations pending continued recruitment to obtain a larger sample size.
77% of DCO patients responded to conservative therapy, and 23% underwent surgery with resolution of symptoms. On follow-up (OR=18; 95%CI=11-31, p<0.001). High frequency (>1x/week) and duration (>5 years) of bench pressing further increased the risk. Pressing with a bench pressing weight (maximum single repetition) of more than 1.5 times the body weight was a risk factor for DCO compared to 209 lbs (±SD 60) in male bench pressers not affected by DCO (n=127; p<0.001, Mann-Whitney). Intense bench pressers who suffered from DCO (n=240), the mean bench pressing weight (maximum single repetition) was 283 lbs (±SD 57) patients were bench pressing on a regular basis compared to 41% in the control group (p<0.001, chi-square). In male bench pressers between 20 and 40 years of age. The prevalence of DCO, the DCO grade (mild, moderate, severe), tendinopathy, impingement, and fatty degeneration are negative prognostic factors for clinical and structural outcome after repair. The 5 point Goutallier classification (Clin Orthop Relat Res 1994) was subsequently simplified by Fuchs (J Shoulder Elbow Surg 1999) into a 3 point system based on the cross-sectional area (CSA) of the supraspinatus (SS) muscle on sagittal oblique (SAG) images with respect to the area of the SS fossa, reported as an occupation ratio (OR). Currently, there are no studies accounting for tendon retraction and its affect on grading.

**METHOD AND MATERIALS**

This IRB approved, HIPAA compliant retrospective study was performed using radiology reports from a single institution. Search terms of 're'traction' or 're'tracted' were applied to non-arthrogram MRI reports from Jan 2014-Jan 2015. Full-thickness SS tendon tears were included. Partial-thickness tears and post-operative cases were excluded. MRI exams were reviewed by an MSK radiologist. Degree of tendon retraction was recorded. Thomazeau CSA and OR was recorded at the standard reference location on SAG images. OR was re-measured correcting for tendon retraction, medial to the reference location, obtaining a new (corrected) CSA. Fuchs grading was applied to both coronal (COR) and SAG planes. Paired Wilcoxon signed-ranks test was used to compare measurements. 25% of the cases were remeasured and independently measured by a second reader and reliability statistics were calculated.

**RESULTS**

79 patients were in the study group (71/150 excluded). Mean SS CSA at the standard vs corrected location was 4.0±1.6 cm² (mean±SD) vs 5.6±1.7 cm² (p<0.001). OR was 0.44±0.13 vs 0.62±0.12 (p<0.001). Standard Thomazeau and corrected stages revealed a concordance of 17.7% (14/79). Concordance for SAG and COR Fuchs staging was 94% (74/79). Inter- and intra-observer reliability statistics were excellent for OR, corrected OR, Thomazeau Stage, and SAG/COR Fuchs (ICC=0.832-0.997).

**CONCLUSION**

Accounting for tendon retraction is important in assessing SS atrophy and can significantly alter the grading using standard systems. Caution should be used when reporting these findings, as SS atrophy may be overestimated.

**CLINICAL RELEVANCE/APPLICATION**

Tendon retraction can result in overestimation of SS muscle atrophy, which may ultimately alter the decision to perform a cuff repair.

**Participants**

Vanessa M. Finato, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Eric Y. Chang, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Brady K. Huang, MD, San Diego, CA (Presenter) Nothing to Disclose

**PURPOSE**

Many rotator cuff muscle classifications are in use, making it difficult to compare results and agree on treatment. Muscle atrophy and fatty degeneration are negative prognostic factors for clinical and structural outcome after repair. The 5 point Goutallier classification (Clin Orthop Relat Res 1994) was subsequently simplified by Fuchs (J Shoulder Elbow Surg 1999) into a 3 point system based on the cross-sectional area (CSA) of the supraspinatus (SS) muscle on sagittal oblique (SAG) images with respect to the area of the SS fossa, reported as an occupation ratio (OR). Currently, there are no studies accounting for tendon retraction and its affect on grading.

**METHOD AND MATERIALS**

This IRB approved, HIPAA compliant retrospective study was performed using radiology reports from a single institution. Search terms of 'retraction' or 'retracted' were applied to non-arthrogram MRI reports from Jan 2014-Jan 2015. Full-thickness SS tendon tears were included. Partial-thickness tears and post-operative cases were excluded. MRI exams were reviewed by an MSK radiologist. Degree of tendon retraction was recorded. Thomazeau CSA and OR was recorded at the standard reference location on SAG images. OR was re-measured correcting for tendon retraction, medial to the reference location, obtaining a new (corrected) CSA. Fuchs grading was applied to both coronal (COR) and SAG planes. Paired Wilcoxon signed-ranks test was used to compare measurements. 25% of the cases were remeasured and independently measured by a second reader and reliability statistics were calculated.

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Tendon retraction can result in overestimation of SS muscle atrophy, which may ultimately alter the decision to perform a cuff repair.

**Participants**

Mika T. Nevalainen, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose
Michael G. Ciccotti, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Johannes B. Roedl, MD, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Many rotator cuff muscle classifications are in use, making it difficult to compare results and agree on treatment. Muscle atrophy and fatty degeneration are negative prognostic factors for clinical and structural outcome after repair. The 5 point Goutallier classification (Clin Orthop Relat Res 1994) was subsequently simplified by Fuchs (J Shoulder Elbow Surg 1999) into a 3 point system based on the cross-sectional area (CSA) of the supraspinatus (SS) muscle on sagittal oblique (SAG) images with respect to the area of the SS fossa, reported as an occupation ratio (OR). Currently, there are no studies accounting for tendon retraction and its affect on grading.

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**CLINICAL RELEVANCE/APPLICATION**

Tendon retraction can result in overestimation of SS muscle atrophy, which may ultimately alter the decision to perform a cuff repair.
imaging, acromioclavicular (AC) joint osteoarthritis was significantly more common in DCO patients treated conservatively than in DCO patients treated surgically (74% vs. 47% p<0.001, chi-square).

**CONCLUSION**

Prevalence of DCO in adults undergoing shoulder MRI is 8%, and females are affected in 9% of cases. Bench pressing more than 1.5 times the body weight is a substantial risk factor. AC joint osteoarthritis is a long-term sequela of conservative, but not surgical treatment of DCO.

**CLINICAL RELEVANCE/APPLICATION**

DCO is associated with AC joint osteoarthritis on follow-up imaging. Maximum bench pressing weight should be kept below 1.5 times the body weight to prevent DCO.

**RC804-05 Non-contrast MRI Diagnosis of Adhesive Capsulitis**

Friday, Dec. 4 9:25AM - 9:35AM Location: E451A

Participants

Andrew S. Chi, MD, MS, Philadelphia, PA (Presenter) Nothing to Disclose
John Kim, MD, San Diego, CA (Abstract Co-Author) Nothing to Disclose
Suzanne S. Long, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Adam C. Zoga, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

The MR arthrographic findings of adhesive capsulitis or frozen shoulder are well described. However, adhesive capsulitis most commonly occurs in patients age 45 to 60 years old, a population for whom direct MR arthrography is rarely ordered. We sought to investigate specific noncontrast MRI findings and constellations of MRI findings in patients with clinical adhesive capsulitis.

**METHOD AND MATERIALS**

A prospective assessment of a retrospective study group was performed. 31 non-contrast, non-arthrographic, shoulder MRI exams were divided into subject and control groups (mean age 55.8 years; 10 men, 20 women). Two blinded MSK radiologists evaluated the MRI exams for coracohumeral ligament thickness >2 mm, fatty infiltration of the rotator interval, and thickening/edema of the inferior joint capsule/axillary recess. Clinical diagnosis of adhesive capsulitis was provided by orthopedic surgery physical exams. One patient with clinical suspicion of adhesive capsulitis was excluded due to concomitant traumatic labral tear, leaving 15 subjects in each group.

**RESULTS**

A triad of MRI findings is associated with adhesive capsulitis. Adhesive capsulitis can be diagnosed on noncontrast shoulder MRI with high sensitivity/low specificity, intermediate sensitivity and specificity, or high specificity/low sensitivity based on the number of MRI criteria observed. Using a single criterion of coracohumeral ligament thickening, sensitivity is 76.7% and specificity is 53.3% for detection of adhesive capsulitis. Using two criteria of coracohumeral ligament thickening and fatty infiltration of the interval, sensitivity is 66.7% and specificity is 55.2%. Using all three criteria of coracohumeral ligament thickening, interval infiltration, and axillary recess thickening/edema, sensitivity is 23.3% and specificity is 86.7%.

**CONCLUSION**

Adhesive capsulitis can be accurately diagnosed on routine noncontrast shoulder MRI in conjunction with appropriate clinical criteria. The finding of a thickened coracohumeral ligament shows strong sensitivity for adhesive capsulitis while the constellation of coracohumeral ligament thickening, subcoracoid fatty infiltration of the rotator interval, and axillary recess thickening/edema yields great specificity for adhesive capsulitis.

**CLINICAL RELEVANCE/APPLICATION**

Routine noncontrast MRI findings in adjunct with clinical findings suspicious for adhesive capsulitis can provide accurate diagnosis without need for direct MR arthrography.

**RC804-06 Extraarticular Shoulder MRI**

Friday, Dec. 4 9:35AM - 10:00AM Location: E451A

Participants

David A. Rubin, MD, Saint Louis, MO (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Modify MR imaging protocols of the shoulder to address suspected abnormalities in the chest wall that may refer symptoms to the shoulder joint. 2) Detect injuries in the shoulder muscles and tendons outside of the rotator cuff, and identify salient features on MR images that guide clinical management. 3) Assess the rib cage using for radiographically-occult injuries.

**RC804-07 Postoperative Shoulder MRI**

Friday, Dec. 4 10:10AM - 10:30AM Location: E451A

Participants

Lawrence M. White, MD, FRCP, Toronto, ON (Presenter) Advisory Board, Siemens AG

**LEARNING OBJECTIVES**

1) Understand the general principles of common shoulder surgical procedures and their expected postoperative appearance at MR imaging. 2) Review the value of MR imaging techniques in evaluation of the postoperative shoulder. 3) Identify MR imaging features of complications or recurrent pathology of the postoperative shoulder.
ABSTRACT

This presentation will cover the expected spectrum of findings in the postoperative shoulder following common modern surgical procedures. The value of MR imaging in the evaluation of recurrent or residual symptoms post shoulder surgery will be reviewed, highlighting the MR imaging features suggestive of complications, or recurrent and residual pathology.

RC804-08  Imaging of the Post Operative Shoulder: Which Imaging Modality is Most Accurate?

Friday, Dec. 4 10:30AM - 10:40AM Location: E451A

Participants
Thomas H. Magee, MD, Indian Harbour Beach, FL (Presenter) Nothing to Disclose

PURPOSE
Post operative shoulder patients are often difficult to image due to scar tissue, metallic artifact, and residual irregularity of anatomic structures. We report the accuracy of MR imaging versus MR arthrography versus CT arthrography in assessment of the post operative shoulder in the same patient population.

METHOD AND MATERIALS
One hundred consecutive post operative conventional shoulder MR and MR arthrography exams performed on the same patients were reviewed retrospectively by two musculoskeletal radiologists. Nineteen of these patients also had CT arthrography performed. Exams were assessed for labral tears and supraspinatus tendon tears. All patients went on to arthroscopy.

RESULTS
Of these one hundred patients, thirty-two had SLAP (superior labral anterior to posterior) tears, sixteen had posterior labral tears, nineteen had anterior labral tears and forty-two had full thickness supraspinatus tendon tears on conventional MR exam. On MR arthrogram exam forty-six patients had SLAP tears, twenty-two had posterior labral tears, twenty-four had anterior labral tears and fifty-one had full thickness supraspinatus tendon tears. MR arthrogram detected fourteen SLAP tears, six posterior labral tears, five anterior labral tears and nine supraspinatus tendon tears not detected on conventional MR exam. Nineteen patients had additional imaging performed with CT arthrography due to metallic artifacts precluding MR assessment of shoulder pathology. There were two SLAP tears, three posterior labral tears, four anterior labral tears and one supraspinatus tendon tear seen on CT arthrography not seen on MR exam.

CONCLUSION
MR arthrography is more accurate than conventional MR in assessment of post-operative shoulder pathology. CT arthrography can detect additional pathology when there is metallic artifact in postoperative patients. It is beneficial to inject a combination of gadolinium and CT contrast at arthrography so CT imaging can be performed post arthrography if metallic artifact precludes imaging shoulder pathology by MR.

CLINICAL RELEVANCE/APPLICATION
MR arthrography is more accurate than conventional MR in assessment of post operative shoulder pathology. It is beneficial to inject a combination of gadolinium and CT contrast at arthrography so CT imaging can be performed post arthrography if metallic artifact precludes imaging shoulder pathology by MR.

RC804-09  Biomeetry of the Glenoid: How to Choose the Right Prosthesis for the Right Patient in Reverse Shoulder Arthroplasty?

Friday, Dec. 4 10:40AM - 10:50AM Location: E451A

Participants
Samii El Ramadan, MD, Besancon, France (Presenter) Nothing to Disclose
Gauthier Menu, Besancon, France (Abstract Co-Author) Nothing to Disclose
Christelle Peyron, MD, Besancon, France (Abstract Co-Author) Nothing to Disclose
Carlos Torres Canovas, Besancon, France (Abstract Co-Author) Nothing to Disclose
Laurent Obert, MD, PhD, Besancon, France (Abstract Co-Author) Nothing to Disclose
Sebastien L Aubry, MD, PhD, Besancon, France (Abstract Co-Author) Nothing to Disclose

PURPOSE
Reverse shoulder arthroplasty has become popular in the treatment of excentrated omarthrosis. However even with up-to-date prosthetic designs and surgical techniques, complications are still frequent. Variations of the glenoid in the general population regarding patient's height, glenoid width and glenoid bone stock, have never been precisely assessed. This could help orthopaedic surgeons to choose the right reverse shoulder implant for one patient. The purpose of the study is 1) to provide a structural analysis of glenoid size and bone stock and 2) to optimize the selection of prosthesis size.

METHOD AND MATERIALS
Sixty-four slice MDCT of 50 normal shoulders were used for this study (Siemens Healthcare, Erlangen Germany). The biometry of the glenoid was assessed on PACS multiplanar and 3D reconstructions: we measured the surface of the largest circle covering the glenoid and being tangent to the inferior rim, the diameter of the circle, the height of the glenoid and the depth of the bone stock at nine representative target points. Glenoid were divided into three groups based on the diameter of the circle and correlation with patient's height and bone stock was performed.

RESULTS
Patient's were 62.42+/-12.87 year old and measured 166.96+/-9.63 cm. There was a significant correlation between patient's height, glenoid surface and glenoid diameter. Glenoid can be subdivided into three size groups: small (diameter<26mm), medium (diameter ranging from 26mm to 28mm) and big glenoid (diameter>28mm). There was no correlation between patient's height and glenoid height. Three target points had a bone stock correlated to glenoid size, whereas other target points did not.

CONCLUSION
Patients can be grouped into three distinct categories based on glenoid diameter but not on glenoid height. Glenoid bone stock and the length of the prosthetic screw is constant except antero-inferiorly.

**CLINICAL RELEVANCE/APPLICATION**

The knowledge of glenoid diameter may be useful to prevent mismatch of prosthetic shoulder implant by choosing between small, medium or big implants.

**RC804-10  Imaging of the Unstable Elbow**

*Friday, Dec. 4 10:50AM - 11:15AM Location: E451A*

Participants
Mark W. Anderson, MD, Charlottesville, VA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) List the primary stabilizing ligaments of the elbow. 2) Describe the role of the ulnar collateral ligament in the development of the valgus overload syndrome. 3) Discuss the bone and soft tissue injuries commonly found after posterior dislocation of the elbow.

**ABSTRACT**

Stability of the elbow depends heavily upon the medial and lateral collateral ligament complexes. This session will focus on the normal anatomy of these ligaments as well as the most common types of ligament pathology that result in elbow instability and the radiographic and MR imaging findings that are seen in these conditions.

**RC804-11  The Legend of the Luschka's Tubercle and its Association with Snapping Scapulae: Osseous Morphology of Snapping Scapulae on 2D and 3D CT Images**

*Friday, Dec. 4 11:15AM - 11:25AM Location: E451A*

Participants
Tony T. Wong, MD, New York, NY (Presenter) Nothing to Disclose
Ronny Li, New York, NY (Abstract Co-Author) Nothing to Disclose
Dana Lin, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Ada Ip, San Ramon, CA (Abstract Co-Author) Nothing to Disclose
Elisa E. Konofagou, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine the osseous morphology of snapping scapulae on CT images in comparison with a control group.

**METHOD AND MATERIALS**

Two and three-dimensional CT images of scapulae of 34 patients with a snapping scapula were compared to a control group of 34 age and gender matched patients without a snapping scapula. Two blinded observers analyzed the following parameters: The presence of the so-called Luschka’s tubercle was rated as yes or no. Measurements of the thickness and length of the superior angle of the scapula, the distance from the superior angle to the inferior angle, the depth of the subscapular fossa, the minimal distance between the scapula and rib cage, and the angle between the superior angle of the scapula and the subscapular fossa were obtained. The superior angle of the scapula was rated as concave or convex. Abnormalities of the rib cage and periscapular soft tissues were noted. The Fisher's exact test and Student's t-test served for data analysis.

**RESULTS**

In snapping scapula patients observer 1 did not find any Luschka’s tubercle while observer 2 detected one Luschka’s tubercle compared to two Luschka’s tubercle in the control group for both observers (p-values<0.48). The superior angle of the scapula was significantly thicker in the snapping scapula group compared to the control group for both observers (observer 1: 4.8±1.3 mm versus 4.1±1.1 mm, observer 2: 5.1±1.6 versus 4.1±1.3 mm, p-values<0.02). The subscapular fossa was significantly deeper in snapping scapula patients compared to control group patients for both observers (observer 1: 21.9±5.0 mm versus 18.8±4.5 mm, observer 2: 28.6±5.9 mm versus 25.1±5.6 mm, p-values<0.035). The comparison of the remaining parameters did not differ significantly between the groups. No abnormalities of the rib cage and periscapular soft tissues were found in snapping scapula patients.

**CONCLUSION**

The superior angle of the scapula was significantly thicker and the subscapular fossa was significantly deeper in patients with a snapping scapula compared to control group patients. The Luschka’s tubercle was rarely seen and not associated with a snapping scapula.

**CLINICAL RELEVANCE/APPLICATION**

CT images may detect subtle osseous variants in patients with a snapping scapula. Neither published original articles nor the present data suggest an association between the Luschka’s tubercle and a snapping scapula.

**RC804-12  Ultrasound Elastography Assessment of Changes in Ulnar Nerve Stiffness with Elbow Flexion**

*Friday, Dec. 4 11:25AM - 11:35AM Location: E451A*

Participants
Lazaros Vlachopoulos, MD, Zurich, Switzerland (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To assess the effects of elbow flexion on ulnar nerve stiffness using ultrasound elastography.
The intraneural pressure of the ulnar nerve (UN) within the cubital tunnel increases during elbow flexion. The purpose of this study is to determine whether ultrasound elastography can detect corresponding changes in nerve stiffness at the cubital tunnel and at defined distances away from it.

**METHOD AND MATERIALS**

Institutional review board and informed consent were obtained. Prospective examination of the UN in twenty elbows for ten consecutive volunteers was performed with ultrasound elastography. Each UN was examined in four positions while the elbow was in full extension: at the cubital tunnel, 4 cm proximal, 4 cm distal, and 8 cm distal. The elbow was then placed in full flexion (145 degrees) for three minutes and the entire examination was repeated. All ultrasounds were performed by a single radiologist on a SonixTouch system (Analogic Corp., Peabody, MA, USA) with a 10 MHz linear array transducer. An acoustic coupler (C) (EZUT-ECPPL1, Hitachi-Aloka Medical) with a standardized elasticity was attached to the probe. Ultrasound radio-frequency (RF) signals were obtained at each time point with a compression-decompression cycle lasting 4-6 seconds. Inter-frame axial displacements of the UN were estimated offline using a 1D normalized cross-correlation-based motion estimation method (Luo and Konofagou 2010) on the RF signals. Based on these displacements, inter-frame strains were computed using a least-squares strain estimator (Kallel and Ophir 1997) and added together to obtain cumulative strains. UN stiffness at each interrogated position was semi-quantified as a mean cumulative strain ratio (C/UN).

**RESULTS**

P-values were calculated using a matched pairs t-test. The change in mean C/UN ratios +/- standard deviation from extension to flexion were as follows: At cubital tunnel: 1.31 +/- 0.98 to 2.41 +/- 0.88 (p-value < 0.00015) 4 cm proximal: 0.50 +/- 0.37 to 0.41 +/- 0.27 (p-value 0.24) 4 cm distal: 1.23 +/- 0.90 to 0.85 +/- 0.91 (p-value 0.14) 8 cm distal: 2.61 +/- 1.41 to 2.01 +/- 1.45 (p-value 0.10)

**CONCLUSION**

Increased UN stiffness within the cubital tunnel can be detected by ultrasound elastography shortly after elbow flexion. No significant changes are detected 4 cm proximal, 4 cm distal, and 8 cm distal.

**CLINICAL RELEVANCE/APPLICATION**

Ultrasound elastography can detect changes in ulnar nerve stiffness during elbow flexion without significant lag time. It has potential for diagnostic use in early nerve compression.

**ABSTRACT**

**Distal Triceps Tendon and Cubital Tunnel**

Friday, Dec. 4 11:35AM - 12:00PM Location: E451A

Participants
Jenny T. Bencardino, MD, New York, NY (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the normal MR anatomy of the distal triceps tendon and cubital tunnel at the elbow. 2) To describe the clinical syndromes that affect the distal triceps tendon and cubital tunnel including insertional triceps tendon tears, snapping triceps syndrome and cubital tunnel syndrome. 3) To review the MR findings associated with distal triceps tendon disease and cubital tunnel syndrome.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jenny T. Bencardino, MD - 2014 Honored Educator
Participants

Sub-Events

RC813A   Imaging of Pediatric Musculoskeletal Infections

Participants
Robert Orth, MD, PhD, Houston, TX (Presenter) Research support, General Electric Company;

LEARNING OBJECTIVES
1) Describe the optimal imaging strategy for evaluating suspected pediatric musculoskeletal infections including specifics of the MRI protocol. 2) List common missed diagnoses and imaging pitfalls. 3) Describe methods for differentiating musculoskeletal infections from alternative diagnoses.

RC813B   Imaging of Osteochondritis Dissecans

Participants
Jonathan D. Samet, MD, Chicago, IL, (jsamet@luriechildrens.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To identify imaging features of osteochondritis dissecans (OCD) using multiple modalities. 2) To recognize the spectrum of findings between low and high grade lesions. 3) To identify the varying postoperative appearances after surgical intervention.

ABSTRACT
For 'Imaging of Osteochondritis Dissecans'1. To identify imaging features of osteochondritis dissecans (OCD) using multiple modalities. 2. To recognize the spectrum of findings between low and high grade lesions. 3. To identify the varying postoperative appearances after surgical intervention.

RC813C   Imaging of Musculoskeletal Soft Tissue Masses

Participants
Michele M. Walters, MD, Boston, MA (Presenter) Nothing to Disclose
Participants
John L. Go, MD, Los Angeles, CA (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss and demonstrate spine biopsy techniques including CT and fluoroscopic approaches, anatomic landmarks, needle selection, special technical considerations for dealing with soft tissue masses, and fluid accumulations, lytic and blastic lesions, and hypervascular conditions. 2) Hands on exposure will be provided in order to familiarize participants with the vast number of biopsy devices that are clinically available. 3) Training models will also be used in order to teach technical skills with respect to approach and technique. 4) Advantages and disadvantages of various biopsy devices and techniques, and improve their understanding of how to maximize the reliability and safety of these spine biopsy procedures.

ABSTRACT

Sub-Events

RC850A Pre- and Post Biopsy Assessment

Participants
Richard Silbergleit, MD, Royal Oak, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Be familiar with all required aspects of the pre-biopsy work-up, including medications, laboratory values, and review of relevant prior imaging. 2) Be familiar with solutions to address to complications or other unexpected events which may arise during the course of spine biopsy. 3) Be comfortable in performing the post procedure assessment of the patient after spinal biopsy.

RC850B Equipment Used for Image-guided Biopsies of the Spine

Participants
Michele H. Johnson, MD, New Haven, CT (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Demonstrate the types of needles used for spine biopsy. 2) Selecting the proper types of needles used for spine biopsy. 3) Case demonstration of the proper use of single or coaxial needle sets for spine biopsy and the advantages or disadvantages of each.

RC850C Thoracic and Lumbar Biopsies

Participants
John L. Go, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the anatomy of the thoracic and lumbar spine relevant to spine biopsy. 2) Describe the approaches used to approach various anatomical regions within the thoracic and lumbar spine. 3) Provide case examples of various approaches used to biopsy the thoracic and lumbar spine.

RC850D Cervical Spine Biopsies

Participants
A. Orlando Ortiz, MD, MBA, Mineola, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Demonstrate the various approaches used to biopsy lesions of the cervical spine. 2) Determine the selection of the proper needles to use to biopsy the spine. 3) Provide case examples of cervical biopsies and the thought process used to perform these procedures.

ABSTRACT

Cervical spine biopsies can be challenging procedures to perform, hence they tend to be performed by a limited number of proceduralists. C-spine biopsy is often performed to evaluate potential neoplastic or infectious processes of the cervical spine. The key to performing these procedures effectively and safely is in appropriate patient selection, careful image analysis in order to properly position the patient and choose an approach, identification of critical structures (such as the carotid artery) and neck spaces that should be avoided, and use of coaxial biopsy techniques. The procedure can be safely performed with CT and/or CT fluoroscopy. Specimen sampling principles and specimen handling are also discussed they can help to optimize this procedure.

RC850E Disc Biopsy and Aspiration
Participants
Amish H. Doshi, MD, New York, NY, (amish.doshi@mountsinai.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.
LEARNING OBJECTIVES

1) An important aspect of Nuclear Medicine and Molecular Imaging is that the same core compound of the administered radiopharmaceutical can be labeled with both gamma emitters (for diagnostic) and beta (or alpha) emitters (for therapy), allowing for the targeted treatment of lesions. This is an expression of theranostics, the combination of therapy and diagnostics that is based on the specific tumor biology of each patient’s disease. This proposed session will provide several examples of such paired diagnostic studies and treatments using Nuclear Medicine methods.

Sub-Events

SPNM61A  Radioactive Iodine and Thyroid Cancer - Current Use and Controversies

Participants
Douglas Van Nostrand, MD, Washington, DC, (douglas.van.nostrand@medstar.net) (Presenter) Speakers Bureau, sanofi-aventis Group

LEARNING OBJECTIVES
1) Define remnant ablation, adjuvant treatment, and treatment of locoregional/distant metastases. 2) Discuss the indications and controversies of 131I for each. 3) Discuss the range of prescribed activity of 131I for each.

SPNM61B  Bone Scintigraphy and the Use of Radionuclides in the Management of Patients with Metastatic Castrate-Resistant Prostate Cancer

Participants
Hossein Jadvar, MD, PhD, Los Angeles, CA, (jadvar@med.usc.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To review bone scintigraphy with single photon and PET radiotracers in the imaging evaluation of patients with prostate cancer. 2) To summarize the results of the ALSYMPCA clinical trial for 223Ra dichloride therapy in patients with castrate resistant metastatic prostate cancer.

SPNM61C  Updates on the Use of PET/CT (and PET/MRI) and Radioimmunotherapy in NHL

Participants
Erik S. Mittra, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

SPNM61D  Peptide Receptor Radionuclide Imaging and Therapy: Where Are We in Europe and What Shall the US Do to Catch Up?

Participants
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the concept of theragnostic. 2) Identify promising candidates for PRRT. 3) Challenges and limitations of PRRT. 4) Future perspective using alpha-emitters.

ABSTRACT

Well-differentiated neuroendocrine tumors (NETs) demonstrate modest responses to conventional chemotherapy due to their slow proliferation rate. However, the expression of somatostatin receptors by NET enables targeting with high affinity peptides. When these octreotide analogue peptides are labelled with beta emitters such as 90Y or 177Lu promising anti-tumor effects have been observed. The presentation will introduce the concept of theragnostic (68Ga-DOTATOC and 90Y/177Lu-DOTATOC) for improved patient stratification. Today, PRRT is well established for a long time in NET-patients. However challenges and limitations will be discussed in regard to other systemic therapies such as everolimus or sunitinib. Finally, outlook will be given in regard to the novel of targeted alpha therapy in NET-patients and its implication to other tumor entities.

URL
Selective Internal Radiation Therapy for Hepatic Malignant Lesions

Ghassan El-Haddad, MD, Tampa, FL, (ghassan.elhaddad@moffitt.org) (Presenter) Speaker Bureau, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.