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### Erosions, but not bone marrow edema or contrast medium enhancement, are specific features in MRI of ankylosing spondylitis patients

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**Purpose / Introduction:** To determine the most relevant radiological features in magnetic resonance imaging (MRI) of sacroiliac joints in patients with ankylosing spondylitis (AS) compared to those with sacroiliac involvement of other rheumatic diseases or degenerative sacroiliac pain.

**Materials and Methods:** We retrospectively analyzed laboratory values, clinical data, and contrast medium enhanced MRIs of the sacroiliac joints of patients (46 male/133 female) admitted to the Radiology Department between 2002–2006 for evaluation of AS-suspicious sacroiliac pain. Standardized MRIs were semi-quantitatively assessed utilizing the SPARCC method for formal statistical comparisons.

**Results:** Of all 179 patients, 27 (15%) were diagnosed with definite AS a mean (SD) of 21.6 (40.5) days after MRI. The remainder had sacroiliac involvement in other rheumatic diseases, HLA-B27 negative spondylarthropathy, or unspecific degenerative changes. While joint space irregularities, bone marrow edema, sub-cortical cysts, and contrast medium enhancement were found in MRIs of all patients, these features were inconsistent, and only erosions were statistically significantly ( $p < 0.02$ ) in patients who were finally diagnosed with AS. The presence of erosions and SPARCC erosion score in AS correlated to a statistically significant degree ( $p < 0.02$ ) with levels of inflammation.

**Discussion / Conclusion:** Erosions alone, not bone marrow edema or contrast medium enhancement, are specific measurable imaging findings in sacroiliac MRI of AS patients.

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### Double bundle ACL anatomy at 3 Tesla

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**Purpose / Introduction:** Before surgical reconstruction of the anterior cruciate ligament (ACL), physical examination

and MRI are the most important preoperative parameters. The double bundle ACL reconstruction technique uses the anatomic double bundle approach of the ACL in order to improve functionality. Magnetic resonance imaging on 3 Tesla (3 T MRI) with arthroscopic correlation has proven to adequately identify the AMB and PLB in cadaver knees. Purpose of this study was to describe the depiction of ACL bundle anatomy on 3 T MRI in daily practice.

**Materials and Methods:** In a retrospective cohort study, we included 50 consecutive patients who underwent standard 3 T MRI of the knee and had an intact ACL. Two musculoskeletal radiologists independently reviewed all scans for depiction of ACL bundle anatomy using standardized forms. Descriptive statistics were used.

**Results:** 23 right knees (46%) and 27 left knees (54%) were included. Mean age of patients was 35 years (range 12–68 years); 37 patients were males (74%). ACL bundle anatomy was best depicted in the axial plane in 44 knees (88%) and in the coronal plane in six knees (12%). Two bundles were seen in 47 knees (94%). The AMB was completely seen in 45 knees (90%). The PLB was completely seen in 40 knees (80%). Both bundles were completely seen in 37 knees (76%).

**Discussion / Conclusion:** The double bundle anatomy of the ACL is visualized in 94% of patients on 3 T MRI. Because of associated clinical consequences we advocate to report separately on the anteromedial bundle and posterolateral bundle in case of anterior cruciate ligament injury of the knee.

3

### Magnetic resonance imaging features of chondroblastoma recurrence

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**Purpose / Introduction:** Chondroblastomas are rare, benign, cartilaginous tumours which usually present in adolescence. They are potentially locally aggressive, therefore surgical curettage followed by bone grafting is the most common treatment. The incidence of local recurrence is high, with reported rates varying from 5 to 38%, typically occurring within 10 months of surgery. The aim of this

study was to identify the MR imaging features of surgically confirmed recurrent disease and to compare these with normal post surgical changes in a control group where there was no evidence of disease recurrence on clinical and imaging grounds.

**Materials and Methods:** A review of our Orthopaedic oncology database was performed to identify patients treated for chondroblastoma over the past 15 years and subsequently diagnosed with a surgically proven recurrence. A control group of an equivalent number was then randomly chosen from our Orthopaedic oncology database with no clinical or imaging evidence of chondroblastoma recurrence. Two dedicated musculoskeletal radiologists independently reviewed the MR imaging studies, blinded to patient outcome, with consensus review.

**Results:** 100 patients were identified as having been treated for chondroblastoma with surgical curettage. Ten patients (10%) developed a histologically proven recurrence during the study period (seven male, three female, mean age 13.3 years). The mean time to recurrence was 9.3 months. In 8 (80%), the recurrence was in a long bone and in 7 (87.5%) the tumour was proximally located. The control group consisted of ten patients (six male, four female, mean age 18.6 years). Increased signal intensity on T2/STIR sequences consistent with bone marrow oedema was present in all patients with recurrence. In addition, soft tissue oedema adjacent to the lesion was evident in all cases. Cortical breach with an extrasosseous mass was identified in 8 (80%). 8 (80%) patients had an associated joint effusion. None demonstrated fatty replacement of the marrow at the site of curettage. In the control group there was no evidence of cortical breach and 7 (70%) showed no evidence of intra or extrasosseous oedema. Fat infill within the surgical bed was identified in 4 (40%) of the control patients.

**Discussion / Conclusion:** The MR imaging features of chondroblastoma recurrence include intraosseous and soft tissue oedema, cortical breach with an extra-osseous mass and adjacent joint effusion. Intraosseous oedema may occasionally be seen in the normal post-operative period but without cortical breach. Fat in-fill on T1 weighted sequences is a normal finding not seen in recurrent disease.

#### 4

##### **Fatigue-type stress fractures of the lower limb associated with fibrous cortical defects/non-ossifying fibromas in the skeletally immature.**

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**Purpose / Introduction:** Stress fractures in the skeletally immature may be mistaken for malignant lesions. The tibia is the commonest site for fatigue-type stress fractures in children and is also the commonest site to be misinterpreted

on imaging as a bone sarcoma. Any additional radiographic abnormalities, such as a fibrous cortical defect (FCD) or non-ossifying fibroma (NOF), may also increase diagnostic uncertainty.

The purpose of this study was to review the clinical and imaging characteristics in a group of paediatric patients with a suspected sarcoma of bone or osteomyelitis, but subsequently shown to have a fatigue-type stress fracture. Particular attention was paid to those cases where a concomitant FCD or NOF may have contributed to initial misdiagnosis and identify any specific differentiating diagnostic features.

**Materials and Methods:** A retrospective study was conducted on paediatric patients referred to an orthopaedic oncology unit, over an 18 year period, with a possible diagnosis of lower limb long bone sarcoma. Those patients subsequently found to have an alternative diagnosis of a fatigue-type stress fracture were selected for the study. Five patients (6%) were found to also have a related FCD or NOF. The clinical findings and imaging features for this group of patients were reviewed.

**Results:** 82 patients (aged < 16 years) were found to have a fatigue-type stress fracture of a lower limb long bone. Over the same period 48 patients were diagnosed with an FCD or NOF. Five cases (four male, one female) were found to have a concomitant stress fracture and either an FCD or an NOF. All were located in the posterior cortex, four posteromedially. The radiographs confirmed typical features of a FCD or NOF in each case and the manifestations of a stress fracture were identified due to organized solid lamellar periosteal reaction. A discrete fracture line was identified in three cases. MR imaging confirmed the cortically-based FCD or NOF. In addition, there was florid hyperintense T2 signal change extending into the meta-diaphysis, typical of marrow oedema, with or without haemorrhage, secondary to the stress fracture. There was no evidence of true cortical destruction or a soft tissue mass.

**Discussion / Conclusion:** The typical imaging features revealed that sarcoma could be effectively excluded in the absence of true cortical destruction and soft tissue extension. Both fatigue-type stress fractures and FCDs/NOFs occur at similar sites in the long bones. Therefore the co-existence of these two conditions in the skeletally immature should be recognised to avoid radiological misdiagnosis.

#### 5

##### **Carpal angles defined by the international wrist investigators workshop (IWIW): Are they reliable**

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**Purpose / Introduction:** Plain radiographs are the first line of investigation of wrist disorder. The etiology of carpal instability includes minor or major trauma and inflammatory arthropathy. The carpal angles are used in clinical

evaluation of standard wrist radiographs. The carpal angles need to be measured reliably to use effectively in diagnosis, treatment and follow up of wrist pathologies. This is much more important in cases of minor trauma as these measurements may be the only clue. Early diagnosis and treatment is necessary to avoid considerable personal and societal loss. The aim of this study was to measure the observer reliability of the most commonly measured angles in standard wrist radiographs.

**Materials and Methods:** 100 wrist radiographs, antero-posterior and lateral taken in true orthogonal planes, were included in the study. The radiographs included 18 men and 25 women, mean age of 48 years (standard deviation 17.44) and male/female ratio was 3:4. The definitions for the scapholunate, carpal angle and lunocapitate angles, and radial inclination were taken from the Wrist Terminology as Defined by the International Wrist Investigators' Workshop (IWIW) 2002. Each measurement was made by two independent observers, and repeated after two weeks, using electronic callipers on a PACS workstation. Reliability measures were calculated using intra-class correlations.

**Results:** The mean difference in measurement of carpal angle was  $1.023^\circ$  (standard deviation  $5.15^\circ$ ) and intraclass correlation coefficient was 0.757. The mean difference in the lunocapitate angle measures was  $4.89^\circ$ , (standard deviation  $8.51^\circ$ ) and intraclass correlation coefficient was 0.477. For radial inclination the mean difference was  $1.71^\circ$  (standard deviation of  $3.6^\circ$ ) with an intraclass correlation coefficient of 0.693. The mean difference for the scapholunate angle observations was  $4.59^\circ$  (standard deviation of  $6.49^\circ$ ) and an intraclass relation coefficient was 0.689.

**Discussion / Conclusion:** Variation of as low as  $5^\circ$  may prove clinically significant. In our study the reproducibility was statistically significant for scapholunate, radial inclination and carpal angle, intraclass correlation being 0.689, 0.693 and 0.757 respectively. However there was significant intra and intraobserver error in measurement of lunocapitate angle with intraclass correlation of 0.47, which we feel could be due to lack of reliably identifying the distal poles of the lunate resulting in error in delineating the axis which subsequently affects lunocapitate and scapholunate angle. We feel that using the IWIW criteria carpal angle, radial inclination and scapholunate can be reliability measured. However one needs to be aware of the significant variability in measuring the lunocapitate angle.

## 6

### **MRI evaluation of cartilage repair in the knee using alginate beads containing human mature allogenic chondrocytes**

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**Purpose / Introduction:** The present study was designed to evaluate the implantation of alginate beads containing human mature allogenic chondrocytes for the treatment of symptomatic cartilage defects of the knee. MRI was used for the morphological analysis of cartilage repair. The correlation between MRI findings and clinical outcome was also studied.

**Materials and Methods:** A biodegradable, alginate-based biocompatible scaffold containing human mature allogenic chondrocytes was used for the treatment of symptomatic chondral and osteochondral lesions in the knee. Twenty-one patients were prospectively evaluated with use of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Visual Analogue Scale (VAS) for pain preoperatively and at 3, 6, 9 and 12 months of follow-up. Of the 21 patients, 12 had consented to follow the postoperative MRI evaluation protocol. MRI data were analyzed based on the original MOCART (Magnetic Resonance Observation of Cartilage Repair Tissue) and modified MOCART scoring system. The correlation between the clinical outcome and MRI findings was evaluated.

**Results:** A statistically significant clinical improvement became apparent after 6 months and patients continued to improve during the 12 months of follow-up. One of the two MRI scoring systems that were used, showed a statistically significant deterioration of the repair tissue at 1 year of follow-up. Twelve months after the operation complete filling or hypertrophy was found in 41.6%. Bone-marrow edema and effusion were seen in 41.7% and 25% of the study patients, respectively. We did not find a consistent correlation between the MRI criteria and the clinical results.

**Discussion / Conclusion:** The present study confirmed the primary role of MRI in the evaluation of cartilage repair. Two MOCART-based scoring systems were used in a longitudinal fashion and allowed a practical and morphological evaluation of the repair tissue. However, the correlation between clinical outcome and MRI findings was poor. Further validation of these scoring systems is mandatory. The promising short-term clinical outcome of the allogenic chondrocytes/alginate beads implantation was not confirmed by the short-term MRI findings.

## 7

### **Multidetector computed tomography arthrography of the knee: diagnostic accuracy and indications**

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**Purpose / Introduction:** To evaluate the diagnostic accuracy and indications of arthrography with multidetector

computed tomography (arthro-MDCT) of the knee, in patients with absolute or relative contraindications to MRI and in patients with periarticular metal implants using diagnostic arthroscopy as the gold standard.

**Materials and Methods:** After intra-articular injection of iodixanol and volumetric acquisition, 68 knees in patients of both sexes (30 females, 38 males, age range 32–60 years) were examined with a 16-detector-row CT scanner. The patients had arthralgia but no radiologically detected fractures. They could not be studied by MRI either because of absolute contraindications (subcutaneous electronic implants), surgical metal implants or claustrophobia. In 37 of 68 patients who had had previous knee surgery, the arthro-CT examination was preceded by an MRI on the same day. All examinations were interpreted by two experienced musculoskeletal radiologists. The findings were compared with arthroscopic findings carried out within 28 days of the CT study.

**Results:** In non-operated patients the comparison between arthro-MDCT and arthroscopy showed sensitivity and specificity ranging between 86% and 100%. In the 37 operated knees, arthro-MDCT had an accuracy of 95% compared with 53% of the MRI. Inter-observer agreement was almost perfect ( $k=0.97$ ) in the evaluation of all types lesions, both on MDCT and MRI. When arthro-MDCT was compared with MRI in post-operative patients by a McNemar test, a significant difference ( $p<0.05$ ) was found between these two techniques.

**Discussion / Conclusion:** Arthro-MDCT of the knee is a safe technique that provides accurate diagnosis in identifying chondral, fibrocartilaginous and intra-articular ligamentous lesions, in patients that cannot be evaluated by MRI, and in patients after surgery.

## 8

### Saving half of acquisition time in standard MRI-knee protocols with specific multicontrast keyhole imaging-technique

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**Purpose / Introduction:** Due to a growing demand on the use of MRI in the area of skeletal radiology, the economy of time is an important criteria of process optimization. Based on MRI of the knee joint, it is demonstrated, how the use of a specific multi-contrast keyhole imaging technique (MCKI) that uses high- and low-frequency components of the k-space for different contrast weightings separately, can produce substantial time savings with respect to a native knee protocol maintaining similar subjective contrast quality of individual sequences.

**Materials and Methods:** 15 patients with different knee joint pathologies were included (mean age  $46\pm$

23). The data were acquired using a full body MRI-scanner (Achieva 3.0 T, Philips) with a 8-channel knee coil with parallel imaging possibilities. The MRI acquisition protocol contained coronal and sagittal TSE-sequences (T1w, PDw, T2w, PDw-fs, T2w-fs). For generation of multicontrast images (MC) the central k-space (keyhole) resp. the low frequency image components of the specific original contrasts (OC: PDw, T2w, PDw-fs, T2w-fs) were used. For filling up the peripheral k-space (high frequency image components) resp. for the sharpness of the image, the T1-weighted image was used (OC: T1w). The smaller the central low-frequency usage of the k-space (k-space-saving), the better is the saving of time. For rating signal contrast and resolution/sharpness, an integer 7-point ordinal-scale by two independent, experienced skeletal radiologists.

**Results:** Regarding the 7-point quality rating-scale a high inter-rater correlation was figured out (Kendall rank-correlation-coefficient:  $t=0.89$ ). Composing fat saturated MC-images (k-space centre: PDw-fs or T2w-fs), a k-space-saving up to 60% was possible without loss of quality concerning signal-contrast and sharpness in any specific tissue or pathological sign. Regarding the non fat saturated PDw- and T2w-MC-images a k-space-saving of even 70% was possible. So, these images needed only 30% of OC-low frequency data in the middle of the k-space. Depending on the amount of shared k-space data, the RMS-error is rising: before a loss of image-quality was verifiable, the RMS error could reach up to 10–15% in fat saturated and to 15–22% in non fat saturated MC-images.

**Discussion / Conclusion:** Using the presented MCKI-technique, its possible to save at least 50% of net acquisition time in standard MRI-knee protocols without loss of quality in the multicontrast images. We suppose successful application of this technique in other joints and regions of the musculoskeletal system with breakeven diagnostic performance compared to monocontrast imaging, also. Especially in radiological units specialised on orthopaedic imaging the MCKI-technique will provide immense economical resources.

## 9

### Magnetic resonance imaging findings of shoulders in Parkinson disease

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**Purpose / Introduction:** Parkinson disease (PD) is a chronic progressive disorder which is characterized by rest tremor, akinesia or bradykinesia and rigidity. Joint and skeletal deformities are common and frequently under-recognized features of PD. The aim of the study was to



draw attention to the lesions of the shoulders in PD with magnetic resonance imaging (MRI) which is the best imaging tool of diagnosis musculoskeletal disorders and answer the question that if there is any difference between the patients with mild and severe PD.

**Materials and Methods:** Fifty-six shoulders of 28 patients with PD (16 women-28.6% and 40 men-71.4%) with an age range of 51–80 years (mean age, 69.4±8.3 years) were included in the study according to Hoehn & Yahr (H&Y) clinical stage and divided into two groups. The first group consisted of 26 (46.4%) shoulders of patients with mild PD (H&Y stage I-II). The second group consisted of 30 (53.6%) shoulders of patients with severe PD (H&Y stage III-IV). As frozen shoulder has a reported cumulative lifetime risk of at least 2% per year in certain population, age-matched control group was not established. All of the patients with PD underwent shoulder MRI. The biceps, supraspinatus, infraspinatus and subscapularis tendon and muscles, the acromiohumeral distance (AHD), the subacromial-subdeltoid and subcoracoid bursa, the glenohumeral and acromioclavicular joints were examined. AHD was measured, and abnormal findings as partial or complete tear, tendinosis, effusion, bone and joint changes were recorded. Data were analyzed statistically by the t-test and Chi-square test.

**Results:** There was no significant difference for all parameters, except two parameters, between the patients with mild and severe PD ( $P>0.05$ ). Unexpectedly, there were significantly higher frequency of tremor ( $P=.045$ ) and subcoracoid effusion ( $P=.002$ ) in the mild PD group than in the severe ones. Although it was not statistically significant, mild PD patients had higher rate of supraspinatus tear (26.9%) than severe patients (16.7%). When we compared two groups according to having rest tremor, not to H&Y, there was higher frequency of complete tear in supraspinatus tendon in the group of patients having rest tremor ( $P=.053$ ).

**Discussion / Conclusion:** Our data suggest that rest tremor may effect the subscapular muscle and may cause subcoracoid effusion, or it may predispose supraspinatus tear as a serious pathology. In the point of view of these results, as a repetitive microtrauma, rest tremor should be taken into importance for the musculoskeletal pathologies in the shoulders of PD patients.

## 10

### Results of surgery and various radiological interventional procedures in the management of osteoid osteoma: Review of cases between 1991 and 2008

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**Purpose / Introduction:** Osteoid osteoma is a painful benign neoplasm of bone with an obscure etiology. Several reports have shown that the osteoid osteoma will heal and become asymptomatic with radiographic disappearance of

the nidus, which can take up to 2 years. The treatment of choice is complete excision. Over time radiological interventional procedures have replaced open surgery in the management of osteoid osteoma, radiofrequency ablation being the latest and most widely used modality. We have reviewed the outcome in patients treated in a district general hospital from 1991 to 2008.

**Materials and Methods:** We have retrospectively analysed the medical notes of patients treated for osteoid osteoma in our institution between 1991 and 2008. All patients were followed up to date. 25 patients formed our study group.

**Results:** There were 17 male and eight female patients with an average age of 19 years (6–55 years). All patients had a radiological diagnosis made with a combination of CT, MRI and bone scintigraphy before interventional procedure. Location of the osteoid osteoma was as follows: tibial diaphysis:7, proximal femoral shaft:4, femoral neck:2, lesser trochanter of femur:2, lamina of C6:1, clavicle:1, distal humeral metaphysis:1, shaft of radius:1, 3 rd metacarpal shaft:2, proximal phalynx of middle finger:1, tibial tuberosity:1, anterior process of calcaneus:1, intermediate cuneiform:1. Osteoid osteoma was an incidental finding in two patients and symptomatic in 23. Symptoms completely resolved in two patients in 9 months time while awaiting intervention. Seven patients underwent open surgical excision, CT guided radiofrequency ablation in 5, CT guided core biopsy in 7, X-ray guided removal in 1 and CT guided laser ablation in 1. Duration of follow up ranged from 3 weeks to 10 years. There was recurrence of symptoms in three patients (14%), 2 following CT guided core biopsy and 1 following radiofrequency ablation a year following the procedure. Of these two patients were treated with open surgical procedure and one with radiofrequency ablation with successful results. Histological diagnosis was consistent with osteoid osteoma in 12 patients. No recurrence was noted in the remaining 18 patients to date.

**Discussion / Conclusion:** Complete excision is the treatment of choice for osteoid osteoma, which can be achieved by open surgery or radiological interventional procedures. Radiological procedures carry less morbidity and allow the patients earlier return to unrestricted activity. In our series 3(14%) patients had recurrence of symptoms following CT guided procedures (2 with core biopsy and 1 with radiofrequency ablation) in contrast to 8–11% reported in literature.

## 11

### Magnetic resonance elastography in trabecular bone: initial experience

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**Purpose / Introduction:** Osteoporotic bone disease is characterized by low bone mass and microarchitectural

deterioration resulting in decreased bone strength, increased low trauma fracture risk and attendant high healthcare costs. Currently the standard method of assessing bone quality is bone mineral density (BMD) and does not include measurements of bone microstructure and architecture, important contributors to bone strength. Magnetic resonance elastography (MRE) is a noninvasive imaging modality for evaluating biomechanical properties of tissue. It has thus far been successfully applied to brain and liver tissue. The aim of this study was to investigate the feasibility of applying MRE to assess the stiffness of trabecular bone (TB).

**Materials and Methods:** Porcine TB cubes were prepared by emersion in 3% sodium hypochlorite for 24 h to remove bone marrow and soaked in 10% Bovine-gelatin to increase T2. 1.5 T MRE images were obtained using gradient and spin echo-based MRE sequences at mechanical frequencies up to 3000 hertz, using a piezoelectric stack mechanical driver. Equivalent 1.5 T MRE images were attained from Wirosil phantoms.

**Results:** In TB, propagating waves were seen at mechanical frequencies up to 3000 hertz. The stiffness map obtained correlated well with the magnitude image, indicating that stiffness contrast can be qualitatively measured. In addition, among the collected 7D data (3D imaging directions, 3D displacement vectors, and time), the most reliable motion directions were consistent with the polarity of the driver, or vibration direction. Propagating waves were seen at frequencies up to 3000 hertz in Wirosil phantoms with resulting elastograms producing a shear modulus similar to known values.

**Discussion / Conclusion:** These preliminary findings show that propagating shear waves can be imaged in TB and indicate that it is feasible to use MRE to assess TB stiffness. Due to its high shear modulus, higher mechanical frequencies will be required to image entire wavelengths. Future investigations will focus on producing higher amplitude, high frequency, mechanical vibrations and further optimizing the imaging sequence to obtain shorter wavelengths in the bone and better spatial resolution of the elastogram. These results support continued evaluation of MRE as a noninvasive diagnostic and prognostic modality to measure overall bone quality in vivo.

## 12

### Sensitivity and specificity of MRI signs in evaluating bucket-handle meniscal tears of the knee

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**Purpose / Introduction:** A meniscal bucket-handle tear is a tear with an attached fragment displaced from the meniscus of the knee joint. Our objective was to

determine the sensitivity and specificity of reported MRI signs in the evaluation of bucket-handle tears of the knee.

**Materials and Methods:** A retrospective analysis of 42 knee MR examinations that were diagnosed as displaying evidence of a bucket-handle or bucket-handle type tear was performed. We assessed for the presence or absence of five MRI signs: a) absent bow tie sign, b) double posterior cruciate ligament (PCL) sign, c) double anterior horn sign, d) disproportional posterior horn sign and e) fragment displaced into the intercondylar notch. Sensitivity and specificity were calculated relative to the gold standard of arthroscopy.

**Results:** Arthroscopy revealed 38 bucket-handle tears in 42 patients (35 males, 7 females). There was a statistically significant male preponderance for the occurrence of meniscal bucket-handle tears. The absent bow tie sign was seen in 25 of 38 cases, the double posterior cruciate ligament sign was seen in 18 of 38 cases, the double anterior horn sign was seen in 15 of 38 cases, the disproportional posterior horn sign was seen in 8 of 38 cases and the fragment in the intercondylar notch was seen in 20 of 38 cases. The absent bow tie sign demonstrated a sensitivity of 86%. The presence of at least one of the displaced fragment signs had a sensitivity of 92%. A finding of both the absent bow tie sign and one of the displaced fragment signs demonstrated a specificity of 89%. The double PCL sign demonstrated a specificity of 99%. The double anterior horn sign had a specificity of 91%.

**Discussion / Conclusion:** A bucket-handle tear of the meniscus is an important and not infrequent type of meniscal injury, occurring in about 10% of most large series. Several signs have been proposed for MRI evaluation. This study gives the sensitivity and specificity of MRI bucket-handle tears using each of these signs independently and in combination. MRI is shown to be very accurate for diagnosing bucket-handle tears especially when two or more of these signs coexist.

## 13

### New positioning devices in kinematic mr imaging of patients with degenerative disc disease-results of a design study

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**Purpose / Introduction:** In patients with degenerative disc disease of the cervical spine, kinematic MR imaging can demonstrate in some patients functional spinal stenosis with myelon compression which can not be seen in standard MRI. Kinematic MRI can be recommended as a complementary examination in the early detection of functional myelon compression and in planing the further therapeutic work-up. However, often only self-made positioning devices of the

cervical spine are used in clinical routine. The purpose of this study was to design and construct new positioning devices for clinical practise and for general purpose.

**Materials and Methods:** In cooperation of the Department of Radiology Vechta, the University Clinic of Kiel, the Muthesius Academy of Fine Arts and Design Kiel and the University of Applied Sciences Kiel, Germany, a group of professors and students designed and developed during a period of 6 months, four positioning devices for functional studies of the cervical spine. Infront of the design and construction process, ergonomical studies of the human body, specially focused on the head, the cervical spine and the thorax were made.

**Results:** All positioning devices were designed and built from nonmetallic materials and were attached to the patient's table. Due to supine positioning and the shape of the supports, maximal comfort was obtained. The devices consisted of a movable support for the head and a stationary frame attached to the patient table. For signal reception, a flexible surface coil was integrated into the system, so that it encircled the cervical spine, allowing free and unrestricted motion. For flexion-extension studies of the cervical spine, different mechanism were developed so that the movable support of the head could be easily adjusted according to length of the cervical spine at flexion and extension. This allowed examinations from 60° extension to about 40° of flexion, by increments of 5-10°. For rotational studies of the cervical spine, i.e. a button at the end of the head support - integrated by a scale of degree- could be turned so that the degree of cervical spinal rotation could be adjusted.

**Discussion / Conclusion:** We believe that the presented newly designed positioning devices can be helpful in a clinical setting to guide cervical spinal motion and achieve sufficient image quality for kinematic MRI studies in patients with degenerative disease at flexion and extension and as well as at rotation.

## 14

### The MRI appearances of local disease recurrence following hindquarter amputation

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**Purpose / Introduction:** Hindquarter amputation involves removal of the entire lower extremity and ipsilateral hemipelvis and is a procedure usually reserved for patients with large bone or soft tissue sarcomas which cannot be widely excised by compartmental resection or a less radical amputation. The anatomical distortion, displacement of pelvic contents and variability in appearance of the amputation flap can cause difficulty when assessing for recurrent disease on post-operative MRI. We describe our experience of the MRI appear-

ances of local disease recurrence in patients following hindquarter amputation.

**Materials and Methods:** Retrospective review of our orthopaedic oncology database, collected over a 30 year period, was performed to identify patients with known recurrent disease or pelvic metastasis following hindquarter amputation. All MRI examinations were reviewed by two Musculoskeletal Radiologists independently with subsequent consensus review. Patient demographics, tumour site, signal pattern and size of the recurrence or pelvic metastasis were recorded. Type and location of the primary tumour were also noted and comparison with pre-operative imaging made.

**Results:** The study group comprised 20 patients (six female, 14 male, mean age 45.7 yrs, range 14-69) with a total of 30 examinations demonstrating recurrent disease or pelvic metastasis. There were 23 recurrences, six metastases and one de novo primary malignancy. 43% (10 of 23) of recurrences were in the muscle component of the amputation flap, 13% (3 of 23) were in the subcutaneous tissues/scar of the flap, 13% (3 of 23) were at the posterior bone resection margin, 13% (3 of 23) were paraspinal and 8% (2 of 23) involved the base of the penis. Of the six patients with metastatic disease, three had bone metastases, one had both multi-focal bone and soft tissue metastases, one had a nodal lesion and one had a retroperitoneal mass. All recurrences were hyperintense on T2 and STIR-weighted imaging. 65% (15 of 23) of recurrences were hypointense, 17% (4 of 23) isointense and 17% (4 of 23) hyperintense on T1-weighted images. In all cases the signal pattern of recurrence closely followed the signal pattern of the original tumour.

**Discussion / Conclusion:** Recurrent disease after hindquarter amputation for pelvic sarcoma is most likely to occur within the muscle flap. The signal pattern of the recurrence typically mirrors that of the original tumour.

## 15

### Stress injuries of the lumbar spine: MR imaging at 1.5 Tesla and comparison with CT

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**Purpose / Introduction:** Spondylolysis is the most common cause of low-back pain in adolescents and it is widely accepted as a stress-induced fracture. Different diagnostic tools have been used in different combinations. The aim of this retrospective study is to compare diagnostic accuracy of MRI with CT in all stages of stress injuries of the lumbar spine, and to determine efficiency of MR imaging as a diagnostic tool in adolescent and young adults in whom radiation exposure is an important consideration.

**Materials and Methods:** Radiologic and clinical data of 92 adolescents and young adults with diagnosis of stress injury of the lumbar spine were retrospectively reviewed. 57 cases who had undergone both 1.5 Tesla MR and 16-slice CT scans less than 2 weeks apart were included in the study group. CT controls were available in 10 out of 27 cases with acute fractures which had been healed with conservative treatment, except in four cases surgical intervention had been performed. Five cases with acute fractures also had undergone MRI control. All MRI and CT scans were retrospectively reviewed and evaluated on separate sessions. MRI findings were graded with a classification system previously reported and CT findings were compared accordingly.

**Results:** A total of 107 stress injuries were detected. Two acute stress reactions were only revealed by MRI. CT and MRI demonstrated 65 chronic non-united complete fractures and 8 acute complete fractures with high consistency. MRI could determine 24 of 32 incomplete fractures which all were demonstrated by CT scans. Both in pedicel and pars interarticularis, all incomplete fractures extended from inferior cortex to superior and healed in reverse direction, as reported recently. MRI findings were inaccurate in four out of 25 acute and four out of seven chronic incomplete fractures. MRI was more accurate at lower lumbar levels, while bilateral fractures at L2 level, two out of four fractures at L3 levels and two out of 16 fractures at L4 levels were incorrectly graded. In five cases who had undergone control imagings with both CT and MRI, three healed and two non-healed progressive fractures were equally demonstrated by both modalities.

**Discussion / Conclusion:** MRI and CT are highly comparable diagnostic utilities in both acute complete and chronic non-united complete fractures. If applied in high magnet field with sequences which shows morphology to best extent, MRI also has high accuracy in acute, early low-grade fractures, especially at lower lumbar levels, L5 and L4, which constitute 95% of all fractures. At upper lumbar levels and in the chronic incomplete fractures of pars interarticularis with marked sclerosis, MRI has apparent limitations when compared with CT imaging.

## 16

### **Preoperative knee MRI: multicenter trial of diagnostic effectiveness variability**

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**Purpose / Introduction:** To analyze variability of preoperative knee MRI by means of multi-institutional study and to investigate limitations of the diagnostic method.

**Materials and Methods:** The study included 200 patients who had had MRI performed at four independent diagnostic centers. All patients were arthroscopically operated by

one orthopedic surgeon. Diagnostic effectiveness of MRI was analyzed for each intra-articular structure (six cartilage regions, both menisci, both cruciate ligaments) with stratification by diagnostic centers. Analysis of variability was based on identification of objective (type of MR system, imaging protocol) and subjective (incorrect interpretation) limitations. Clinical decision rules were developed on the basis of cost-effectiveness analysis.

**Results:** Analysis of combined data provided highest MRI accuracy for posterior cruciate ligament tear (94%), patellofemoral and lateral femoral condyle cartilage defects (85 and 81%). Highest PPV (94%) was found for anterior cruciate ligament tears. Highest PPV was found for anterior cruciate ligament tears (94%) and medial femoral condyle cartilage defects (87%). Highest NPV was found for posterior cruciate ligament tears (99%) and patellofemoral cartilage defects (87%). The greatest variations of sensitivity were found for diagnosis of posterior cruciate ligament tear and lateral tibial condyle defects. The greatest variations of specificity were found for diagnosis of anterior cruciate ligament and menisci tears. Major reasons for low diagnostic effectiveness were incomplete imaging protocol and misinterpretation of MRI symptoms.

**Discussion / Conclusion:** Preoperative MRI of knee joint is characterized by high variability of diagnostic effectiveness. Standardized imaging protocol is a pre-requisite for including MRI into clinical decision rules.

## 17

### **Free projection of elbow joint on lateral x-rays: a modified technique**

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**Purpose / Introduction:** The elbow is a complex joint consisting of a radiohumeral, radioulnar and an ulno-humeral part. Strict lateral x-rays lead to slight overlap of humeral trochlea, radial head and olecranon on conventional x-rays in almost all cases. Strictly lateral view is taught as standard in common text books for radiologists and radiographers. Despite correct technique joint space cannot be viewed freely. As anatomy of the elbow joint is complex computed tomography (CT) or magnetic resonance imaging (MRI) are often performed for further evaluation. Our goal was to find an easy to perform method for free lateral viewing of the elbow joint on lateral x-ray projections.

**Materials and Methods:** Forearm and upper arm were seated by using conventional wedges of foam and a goniometer. Elevation was tested degree by degree over years until a reproducible free projection of radial head, olecranon and humeral trochlea resulted. Every patient was only x-rated once.

With a combination of an elevation of the upper arm of 10 degrees and of the forearm of 15 degrees a free



projection of the elbow joint resulted. With this modification 76 patients were x-rayed in a period of 8,2 month. 42 were males and 34 females. Optimal few was defined as orthograd few of olecranon and head of radius with an overlap of 0–1 millimeter. A satisfying view was defined as an overlap of 1–2 mm. Not satisfying >2 mm.

**Results:** By a combination of an elevation of the upper arm of 10 degrees and of the forearm of 15 degrees a free projection of the elbow joint resulted. These measures can be performed by using a simple goniometer and standard wedges of foamed plastic. No extra time is needed. No additional costs are made. Technical handling of this 10/15 technique is shown during lecture. 78,95% ( $n=60$ ) of patients had an optimal orthograd view of olecranon and head of radius with free joint space. Another 17,11% ( $n=13$ ) had a satisfying result with slight overlap and good view of joint space. 3,95% ( $n=3$ ) had a not satisfying result.

**Discussion / Conclusion:** Due to anatomical conditions the elbow joint shows an overlap of radial head, humeral trochlea and olecranon in the joint space on strictly lateral x-ray views. Due to this conditions magnetic resonance imaging (MRI) or computed tomography (CT) are often performed to exclude bony formations or fragments in joint space. By using this 10/15 degree modification on lateral views, a free projection of radial head, trochlea and olecranon resulted in most cases. 96,06% of patients had an optimal or satisfying free view of joint space.

## 18

### **Percutaneous CT-guided radiofrequency ablation for the treatment of osteoid osteoma and osteoblastoma of the spine.**

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**Purpose / Introduction:** Our aim is to present our experience with percutaneous CT-guided radiofrequency ablation of spinal osteoid osteoma and osteoblastoma as an alternative to surgical resection

**Materials and Methods:** We report sixteen cases of spinal tumors adjacent to the neural elements. Fourteen of these cases were treated with CT-guided radiofrequency coagulation. The procedures were performed on an outpatient basis. One osteoid osteoma was localized in the cervical spine, four in the thoracic spine and the remaining seven in the lumbar area. The pedicle was involved in three cases, the pars interarticularis and superior facets in four cases and the laminae in other three cases. One osteoblastoma was located in the lumbar spine and another in the sacrum. CT has been the standard imaging technique to evaluate the location and the size of the tumor, and to establish if the cortex was intact between the nidus and the spinal canal.

**Results:** Pain disappeared post-RF ablation in eleven patients within 10–15 days. One patient reported pain in the course of the first month after the procedure. Recurrence of the pain was observed in two patients in the whole study group. The RF ablation was repeated in these cases, achieving successful results in both patients. Our primary and secondary clinical success rates were 80% and 100% respectively.

**Discussion / Conclusion:** CT-guided percutaneous radiofrequency ablation of vertebral osteoid osteoma and osteoblastoma is a safe and effective method that should be considered the procedure of choice for most of these cases. The technique may be contraindicated when no intact cortex is evident between the nidus and the neural structures.

## 19

### **Evaluation of lateral ankle instability with weight-bearing MRI. Preliminary experience**

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**Purpose / Introduction:** To assess the usefulness of weight-bearing examination of the ankle performed with a dedicated MRI scanner in the evaluation of patients with clinical evidence of lateral ankle instability.

**Materials and Methods:** We retrospectively evaluated ankle MR examinations of 18 patients, performed between September 2008 and January 2009. Spin echo T1W, Turbo Spine Echo T2W, 3D Steady-State (SSE) and Short Tau Inversion Recovery (STIR) images were acquired with a 0.2 T scanner (G-Scan, Esaote Spa, Genoa, Italy) in both weight-bearing position and normal conventional supine position. A dedicated extremities receiver coil was used. In present, signs of instability and ligament signal intensity changes were evaluated in consensus by three musculoskeletal experienced radiologists.

**Results:** The conventional supine position showed a partial tear of anterior talo-fibular (ATF) ligament in 12/18 patients, a complete tear of ATF ligament and a partial tear of the calcaneo-fibular (CF) ligament in 3/18 patients, while in the remaining three patients there was presence of post-traumatic bone oedema without ligament disruption. The weight-bearing position showed that in 5/12 patients with a partial tear of ATF ligament seen in normal conventional supine position there was instead a complete tear of ATF ligament along with a partial tear of CF ligament. Moreover, only in the weight-bearing position a subtle plantar fascia partial tear was detected in one case, while in the conventional supine position there was evidence only of high-grade plantar fasciitis. In the remaining patients, conventional supine position and weight-bearing position demonstrated the same lesions without lesion grading changes.

**Discussion / Conclusion:** Imaging the ankle in weight-bearing position with a new developed MRI scanner is useful in demonstrating complete tears of the ATF ligament that are doubtful or defined as partial tear in normal conventional supine position. Moreover, in one case the weight-bearing position showed occasionally a subtle plantar fascia tear, which can be overlooked when imaging the ankle only in supine position.

## 20

### Validation of fluoroscopically controlled lumbar facet joint injection using oblique needle technique in degenerative lumbar spine syndrome

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**Purpose / Introduction:** In clinical practice fluoroscopically controlled facet joint block (FJB) becomes a routine diagnostic procedure for diagnosis of facet joint syndrome (FJS), although FJS is not accepted as a separate entity in the literature completely. The clinical picture of degenerative FJS is unspecific and routine reliable and valide predictor-criterias for a positive lumbar FJI couldn't be established, till now. Diagnostic imaging (x-ray, MRI, CT) show no reliability, low predictive value and limited correlation between radiological and clinical picture. There are doubts of single FJB with facet joint injection (FJI) using local anesthetics being able to identify facet joint as cause of low back pain. A high rate of false positive test results is discussed.

**Materials and Methods:** After positive vote from the ethical commission, following three-period cross-over single-blinded, pseudo-placebo and placebo controlled, prospective and randomized clinical study design was performed. After written informed consent, 60 patients with LBP >6 months, spondylarthrosis in conventional X-ray and no effect of conservative treatment were randomized in six groups (ten patients per group). 3 defined test injections were given to each patient (time intervals >8 h): sicca (needle para-articular, no volume), placebo (1,5 ml sodium chloride (0,9%), intra-articular), verum (1,5 ml Scandicaine (0,5%), intra-articular). The injections were done flurosopically controlled, patient in 30–45° supine position (oblique needle technique). Main outcome variable is the difference before and after injection on a 10-point-VAS-scale. Time of patient documentation was immediately before injection and 30 min., 60 min., 2–3 h, 6–8 h after each injection. Explorative data analysis with using a mixed linear model was done; test for equivalence. Independent variables were: type of injection, carry-over effect, period effect, patient as random effect (repeated measurements).

**Results:** A period effect and a carry-over could not be demonstrated at any time after injection. There were no

disruptive influences between the injections. Sicca injection showed only a 0.7–0.9 point difference to verum-infections. At time 1 und 2 p.i. nearly 30% were non-responder. Without these, verum-responder-rate was 70%, more than half of them (56%) were false positive. Placebo-responder-rate was high (52%), sicca-responder also (42,5%). The test for equivalence showed quivalence between Scandicaine-, sodium chloride- and sicca-infection ( $\alpha=0.05$ ,  $p<0.05$ ).

**Discussion / Conclusion:** The high non-responder rate confirms the lack of clinical and radiological reliable and valide pretest predictors for FJB. There is a high rate of placebo effects (sicca 30–40%). The validity for a single flurosopically controlled FJB for diagnosis of FJS is insufficient.

## 21

### Evaluation of supraspinatus tendon tears with elastosonography in comparison to US and MRI. Our experience

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**Purpose / Introduction:** Elastosonography is a new promising ultrasound tool that can evaluate soft-tissue elasticity, in particular that of the tendons. The purpose of this study was to value the elasticity of the supraspinatus tendon in shoulders with clinically suspected unilateral rotator cuff tear, and to compare the findings with those of US and MRI.

**Materials and Methods:** 36 shoulders of 18 patients (mean age 46 years; range: 32–58 years) were examined by elastosonography using the EUB, Hitachi 7500 Japan. Electronic array transducer of 13 MHz was used. By elastosonography, we have evaluated the tendon fibers with a semiquantitative score of different colors representing stiff tissue (blue) to more soft tissue (green, yellow, red). The findings of elastosonography in the affected side (18/36) were compared to those of grey scale (B-mode) and to those of a subsequent MRI exam.

**Results:** In the affected shoulder of the patients, partial tears were assessed as areas of color changes (yellow and red) not reaching the bursal or articular aspects, as in full-thickness tears. Elastosonography showed 10/18 partial tears, and 8/18 full-thickness tears; in contrast, B-mode showed 12/18 partial tears, and 6/18 full-thickness tears. MRI confirmed the findings of elastosonography. Tendons of the contralateral healthy shoulder (18/18) were almost invariably blue or green, consistent with normal stiff tendon tissue, matching with the grey scale findings of normal tendon fibrillar echotexture.

**Discussion / Conclusion:** Elastosonography correctly diagnosed a full-thickness tear in 2 cases, while B-mode did

not, because of the presence of granulation tissue that simulated degenerated tendon fibers changing the lesion grading from a full-thickness to a partial-thickness tear. In all patients, elastosonography findings correlated well with MR image, although the size of the tear in some case was larger with MR, presumably because of the additional high signal of perilesional oedema. Elastosonography is a sensitive method for diagnosis of supraspinatus tendon tears. Detection of tissue softening could add some confidence in the diagnosis of a complete tear in cases of doubtful B-mode images, and this might have an impact on therapeutic decisions.

## 22

### **MRI follow up of the lower musculoskeletal system in 63 running amateurs during training period and after their first marathon competition**

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**Purpose / Introduction:** Results of a longitudinal MRI-follow up-study during the whole training period and (half-)marathon-competition in running beginners are presented. It is a qualitative and quantitative MRI-analysis of impact related changes and pathologies of the whole lower musculoskeletal system (from lumbar spine to forefoot) in running beginners. **Materials and Methods:** In 63 running amateurs (and for comparison in ten (semi-)professional marathon runners) a standard MRI-protocol (half body-TIRM, fat saturated PDw, quantitative cartilage mapping of knees, ankles and midfoot, muscle diffusion imaging) of lumbar spine, pelvis, hips, knees and ankles with feet at three fix points of time were performed: at the beginning of the training period (6 months), after the training period and shortly after the marathon competition (2–30 h). Depending on injuries and disorders and MRI-abnormalities, additional specific focused MRI-scans were done during the training period up to 8 weeks after the competition.

**Results:** 27% of the running amateurs were eliminated during the training period due to somatic disorders (in 90% problems with the lower musculoskeletal system). Regarding underlying localities and entities, the causes were multifold. In two of three cases, these problems were related to previous disorders, which were detectable with the primary MRI. In the other cases, MRI-sensitive disorders were caused by running impact (e.g. tibial stress fracture, fasciitis plantaris, Achilles tendinopathy). Primary cartilage damage were not initiated by marathon training. However, previous chondropathia resp. focal arthritis showed measurable worsening in different ways and in different joints leading to limitation of athletes activity.

**Discussion / Conclusion:** Running amateurs of more than 30 years of age, should get an MRI of the lower extremities

before training for their first marathon distance. Physical examination on its own is not able to detect relevant pathologies contraindicating this sport. As our study shows, this is the only way to prevent threatening claims on the musculoskeletal system induced by long distance running.

## 23

### **Clinical and MRI follow-up in 123 consecutive patients after percutaneous US guided ablation of shoulder tendons calcifications**

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**Purpose / Introduction:** Evaluation of clinical and radiological response to US guided percutaneous needle aspiration and lavage of symptomatic calcific tendonitis of the shoulder; evaluation of tendon structure at 6 months control. **Materials and Methods:** From September 2006 to June 2008 124 shoulders of 123 consecutive symptomatic patients were treated percutaneously by using US guided needle technique. Patient were evaluated by using Constant Score, RX, US and Magnetic Resonance obtained immediately before the treatment and for all patient at 6 months or later. Patients still suffering after the procedure had second treatment.

**Results:** In almost all patients of our series significant improvement was seen at 6 month control; from 30,55 (16,75 sd) Constant score points preoperatively to 76,65 (11,83 sd) points at 6 months or later ( $p < 0,00001$ ). 42% of patients needed a second procedure because of calcific residuals (12) and/or bursal steroid infiltration (41). 63% (78) of our patients suffered impingement syndrome visualised by MRI; 66% of these patients needed a second procedure. Clinical examination didn't point out any symptom or sign of tendon break; MRI demonstrated in some cases doubtful images of tendon discontinuity, not confirmed by clinical and US examination.

**Discussion / Conclusion:** percutaneous US guided treatment of calcific tendonitis of the shoulder proved to be effective; some patients needed second procedure (or more in few cases) because of subacromial bursitis, a complication more frequent when subacromial impingement exists. We suggest to consider the therapy as a two steps treatment in order to take care of bursitis. Impingement syndrome reduce the effectiveness of the procedure. In some cases MRI point out doubtful images; we suggest to consider them as false images of tendon break.

## 24

### **Radiocarpal versus distal radioulnar MR arthrography in the evaluation of the triangular fibrocartilage**

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**Purpose / Introduction:** Peripheral tears of the ulnar attachment of the triangular fibrocartilage are frequently missed. The aim of this study is to evaluate the accuracy of radiocarpal and distal radioulnar MR arthrography in suspicion of peripheral tears of the triangular fibrocartilage.

**Materials and Methods:** 28 patients with clinical suspicion of ulnar attachment tear underwent radiocarpal MR arthrography and successively, within one month, distal radioulnar MR arthrography. We injected an average of 4 ml of contrast medium in the radiocarpal joint instead of 3 ml in the distal radioulnar joint.

**Results:** In nine patients communicating tear of the ulnar attachment was diagnosed both at radiocarpal and distal radioulnar MR arthrography; in eight patients this diagnosis was confirmed by arthroscopy. In one patient only radiocarpal access depicted noncommunicating tear with elective involvement of distal lamina. In three patients solely distal radioulnar arthrography depicted two lesions of proximal lamina and one communicating. With radiocarpal MR arthrography sensitivity was 73% and specificity was 88%; with distal radioulnar MR arthrography sensitivity was 92% and specificity was 94%.

**Discussion / Conclusion:** Distal radioulnar MR arthrography is the best choice to depict peripheral tears of the triangular fibrocartilage.

## 25

### Ultrasound guided aspiration for painful hips in children; should it be performed?

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**Purpose / Introduction:** Acute onset hip pain in children can be caused by transient synovitis and more sinister conditions including septic arthritis. The symptoms of pain and inability to weight bear can last up to 5 days, with need for hospitalisation and skin traction. This study aims to test the hypothesis that aspiration of an effusion in paediatric patients reduces the symptoms and duration of hospital stay.

**Materials and Methods:** A retrospective study was performed. All patients, under the age of 18, undergoing hip ultrasound examination for acute onset hip pain, were identified between 01/07/06 and 31/12/07, from the radiology records CRS system. Of these, the patients who underwent a hip aspiration were identified. The medical records of the patients were reviewed and data regarding the symptoms, laboratory results, results of aspiration, need for surgical intervention, use of traction and duration of hospital stay was recorded. Complications related to the aspiration and sequelae of the original condition were recorded.

**Results:** 99 patients underwent an ultrasound for acute onset hip pain. 39 patients had a hip effusion. 34 patients

underwent an aspiration. 14.7% ( $n=5$ ) patients reported immediate pain relief. Inpatient stay did not exceed 24 h for any patient. No patient required skin traction. There were no complications related to the aspiration. Among the five patients, where the effusion was not aspirated, one patient required hospitalisation for 3 days. One patient required IV antibiotics. One patient required two subsequent admissions for pain relief. Two patients needed further MRIs.

**Discussion / Conclusion:** We propose that aspiration of a hip effusion in children presenting with acute onset of hip pain can not only exclude sinister conditions like septic arthritis, but also reduce the duration of the patients symptoms and hospital stay.

## 26

### Radiological investigation of soft tissue peripheral nerve sheath tumors appearance, with US, MRI

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**Purpose / Introduction:** objective of this study was to describe the imaging findings of soft tissue peripheral nerve sheath tumors (PNSTs).

**Materials and Methods:** 19 patients (12 women, 7 men of mean age 20–50 yrs) with surgical and histological examination-confirmation, underwent US examination, with linear transducer 7–12 MHz and MRI imaging with T1W1, T2W2, T2W2 f-s, T1W1+Gd(f-s) sequences in the sagittal, coronal and axial planes.

**Results:** We examined 10 PNSTs (schwannomas, neurofibromas), located on ulnar nerve(3), median n.(3), radial n. (1), tibial n.(2), peroneal n.(1) and 9 Morton neuromas. All the lesions appeared, as well defined masses, with fusiform or spherical shape, homogenous hypoechoic echotexture in US and hypointense to muscle on T1W1 sequence, hyperintense on T2W2 and homogenous enhancement after iv contrast injection. The afferent and efferent nerve entering or exiting from the tumor was seen in all cases using high resolution transducers.

**Discussion / Conclusion:** US and MRI are important examination tools in diagnostic interpretation of PNSTs. US examination is the method of choice in showing the afferent and efferent segment of the affected nerve from the tumour.

## 27

### Magnetic resonance imaging characteristics of knees of a healthy population and of early knee osteoarthritis and the relation to pain and disability

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**Purpose / Introduction:** Investigating the presence of joint abnormalities using Magnetic Resonance Imaging (MRI) and the relationship to pain and disability in early knee osteoarthritis (OA).

**Materials and Methods:** MRIs of the knee were obtained in 155 cases (median age 56 years, 78% women) with early knee OA defined as pain or stiffness for which not more than 6 months ago consultation of a general practitioner and 30 age and sex-matched controls without OA. MRIs were analyzed for various OA features. Odds ratios (OR) with 95% confidence intervals were used to determine the relative risk of OA in relation to the imaging parameters. Sensitivity and specificity for imaging parameters were calculated. Multivariate analysis was performed for the association between imaging parameters and clinical features of OA. Adjustments were made for confounders.

**Results:** Osteoarthritic features at MRI were demonstrated in normal controls but more frequent in OA patients. The ORs of cartilage defects, osteophytes, cysts, bone marrow lesions and intrasubstance degeneration were 3.8 (1.6–9.1), 3.2 (1.4–7.6), 2.9 (1.0–8.1), 4.5 (1.5–13.9), 2.3 (1.0–5.4) respectively for OA compared to controls. Sensitivity ranged from 14–68% and specificity from 57–90%. OA patients reported higher scores for pain and stiffness in the presence of osteophytes and meniscal subluxation ( $p < 0.05$ ) respectively. Lower scores were observed in the presence of joint effusion and Bakers cysts.

**Discussion / Conclusion:** Osteoarthritic features are present in controls and although more frequent in early OA, no single MRI feature distinguishes OA from non-OA. Especially osteophytes and meniscal subluxation are associated with symptoms in these early patients.

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### Comparison of diffusion weighted and dynamic enhanced subtracted MRI with bone scintigraphy in the diagnosis and prognosis of Perthes disease

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**Purpose / Introduction:** To compare diffusion weighted (DWI) and dynamic gadolinium enhanced subtracted (DGS) MRI with pinhole scintigraphy (PSc) in the diagnostic work-up and the prognostic assessment of Legg Clave Perthes disease (LCP).

**Materials and Methods:** Twelve male patients with unilateral LCP disease were referred for PSc and MRI which included DWI and DGS sequences (mean time interval between imaging sessions=6 days). Patients were assessed scintigraphically based on the Conway classification. At DGS, the presence or absence of lateral pillar enhancement was correlated with PSc findings using the

Cohens Kappa test. Likewise, the apparent diffusion coefficients (ADC) in the affected and the contralateral epiphysis and metaphysis were measured and compared with the asymptomatic, healthy side using the Wilcoxon test as well as correlated with PSc findings ipsilaterally using Cohen s Kappa test. Based on PSc as the gold standard, each of these variables was analyzed by receiver operation characteristics curves (ROC), and areas under the curve (AUC) were assessed with respect to the detection and prognosis of LCP.

**Results:** Agreement between DGS and PSc was perfect regarding prognosis ( $\kappa$  value=1.0). The sensitivity, specificity as well as the positive and negative predictive value of ADC epiphyseal values above a cut-off of 0.89 mm<sup>2</sup>/1000 s was 100%, respectively, for the diagnosis of LCP (95% confidence interval (CI95%)=73.5100). The sensitivity and specificity of ADC metaphyseal measurements was 66.7% (CI95%=35–90) and 100% (CI95%=74–100), respectively, using a cut-off value of 1.042 mm<sup>2</sup>/1000 s. With regard to prognosis, the accuracy of increased ADC values in suggesting a poor outcome was low in the epiphysis (AUC=0.686; sensitivity=86%; specificity=60%; CI95%=50–100) but relatively high in the metaphysis (AUC=0.800; sensitivity=100%; specificity 80%; CI95%=62–100) using cut-off values of 1.193 mm<sup>2</sup>/1000 s and 1.000 mm<sup>2</sup>/1000 s, respectively.

**Discussion / Conclusion:** In our study population, the diagnostic accuracy of DGS MRI was identical to PSc in Perthes disease. Increased ADC in the femoral epiphysis appears to be an excellent diagnostic criteria but carries a low prognostic significance. Increased ADC in the metaphysis, however, correlates well with poor clinical outcomes.

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### Normal post-operative MRI appearances following hindquarter amputation

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**Purpose / Introduction:** Hindquarter amputation involves removal of the entire lower extremity and ipsilateral hemipelvis and is reserved for patients with large bone or soft tissue sarcomas which cannot be widely excised by compartmental resection or a less radical amputation. Our aim is to describe the normal post-operative MRI appearance following hindquarter amputation focusing in particular on the post-operative anatomy and pattern of morphological and time-related signal changes identified within the myocutaneous amputation flap.

**Materials and Methods:** A retrospective review of our orthopaedic oncology database was performed to identify

patients who had undergone hindquarter amputation with myocutaneous flap reconstruction. Patient demographics, primary tumour, type of flap and surgical procedure were recorded in each case. Examinations were divided into groups according to their time interval from surgery. Subjective assessment of the dimensions of the flap and signal changes within its muscle and subcutaneous components were made. Where complications of surgery or recurrent tumour were identified, those examinations were excluded. The examinations were independently assessed by two experienced musculoskeletal radiologists with subsequent consensus review.

**Results:** The study group consisted of 18 patients (seven female, nine male, mean age 44 years, range 16–75) with a total of 47 examinations reviewed. Between 0–6 months after surgery, 100% (10 of 10) of examinations showed hyperintense T2 and STIR signal within the muscle flap. By 4 years, muscle flap signal had returned to isointense on these sequences in all cases (13). Between 0–6 months after surgery, 50% (5 of 10) of examinations demonstrated swelling and mass effect of the muscle flap but of examinations performed 1 year after surgery, 100% (28 of 28) showed flap atrophy. 20% (2 of 10) of examinations performed between 0–6 months showed hyperintense T1 signal within the muscle flap consistent with fatty infiltration. By 2 years from surgery, 100% (20 of 20) showed hyperintense T1 signal within the muscle flap.

**Discussion / Conclusion:** A pattern of time-related signal and morphological change is observed within normal hindquarter amputation flaps on post-operative MRI. Atrophy and fatty infiltration of the muscle flap evolve over time. Oedema in the muscle flap persists for a significant period after surgery but does eventually resolve.

### 30

#### Value of whole-body MRI in correctly staging monoclonal plasma cell disease Comparison of the Durie/Salmon and the Durie/Salmon PLUS staging system

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**Purpose / Introduction:** Whole-body MRI (wb-MRI) was used to investigate the concordance of the Durie/Salmon (D/S) with the Durie/Salmon PLUS (D/S PLUS) staging system regarding focal or diffuse infiltration in all stages of monoclonal plasma cell disease.

**Materials and Methods:** 403 untreated patients (22–86 years of age) with monoclonal gammopathy of undetermined significance (MGUS,  $n=84$ ), plasmacytoma ( $n=17$ ), amyloidosis ( $n=12$ ) and multiple myeloma in all stages (MM,  $n=325$ ) were examined with wb-MRI on a 1.5 T-

system using T1 and fat-suppressed T2-weighted sequences of the head, thorax, abdomen, legs, and spine yielding composed scans between the skull vertex and the feet excluding the distal forearms. Two blinded radiologists assessed in consensus the bone marrow infiltration pattern and focal lesions, and also distinguished between intraosseous, corticalis-exceeding, and soft tissue lesions with regard to D/S and D/S PLUS.

**Results:** Six MGUS patients (7%) and 10 plasmacytoma patients (59%) showed focal lesions leading to an upgrading as MM stage IB ( $n=12$ ), IIA ( $n=3$ ) or IIIA ( $n=1$ ) in D/S PLUS. In 290 MM patients (all stages) only eight patients (3%) would have been staged higher in D/S PLUS in comparison to D/S. In all amyloidosis patients wb-MRI led to no change in classification. Among all 403 patients of our population, 24 patients (6%) would have been staged higher in D/S PLUS when compared with D/S using wb-MRI.

**Discussion / Conclusion:** The classical D/S staging system is accurate in advanced disease, whereas in case of limited disease (MGUS, plasmacytoma) wb-MRI reveals more lesions and thus yields a more accurate classification.

### 31

#### Quantification of synovitis in rheumatoid arthritis: do we really need quantitative measurement of contrast-enhanced ultrasound?

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**Purpose / Introduction:** The quantification of synovitis is of great significance for adequate therapy management and follow-up in patients with Rheumatoid Arthritis (RA). The purpose of this study was to validate a semi-quantitative Power Doppler (PD) scoring system by comparing the PD scores to the objective measurement of the synovial inflammation using dynamic contrast-enhanced Pulse-Inversion Harmonic Imaging (PIHI).

**Materials and Methods:** In 27 patients with RA, two radiologists performed semi-quantitative scoring of a PD examination, using a four-point scale from 0 to 3, in the metacarpophalangeal joints, proximal interphalangeal joints, and the wrists. The scores were compared to the area under the time-echo intensity curves obtained by contrast-enhanced PIHI examination. The interobserver agreement for PD scoring was evaluated using the Cohens kappa test.

**Results:** Preliminary results showed that the area under the curve of dynamic measurements of PIHI tended to correlate with PD scores. The interobserver agreement for PD scoring was excellent ( $\kappa=0.768$ ).

**Discussion / Conclusion:** Based on comparisons with dynamic contrast-enhanced PIHI, semi-quantitative PD scoring might meet the criteria for a reliable, reproducible, and practical scoring system. Although further studies that would include a larger study population are required, our preliminary results show that PIHI may not provide a real benefit for quantification of synovitis in day-to-day practice and should be reserved for equivocal, controversial cases.

### 32

#### **Anatomical study of superficial peroneal nerve using ultrasonography**

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**Purpose / Introduction:** The purpose of our study was to demonstrate that ultrasonography may allow a precise assessment of the course and relationships of the superficial peroneal nerve (SPN).

**Materials and Methods:** This study, initially undertaken in nine cadavers, was followed by high resolution ultrasonographic study in 30 volunteers (60 legs) by two radiologists in consensus. The location, course and relationships to the adjacent anatomic structures of the SPN were analyzed.

**Results:** The entire course of the SPN could be identified by ultrasonography. The level of the proximal emergence of the SPN between the peroneus longus and extensor digitorum longus muscles, and its level at which it pierces the crural fascia and becomes subcutaneous were found to be highly variable. The SPN was found to be located in the anterior compartment in 26.6% of the cases and to divide before piercing the crural fascia in 6.6% of the cases.

**Discussion / Conclusion:** The SPN can be clearly depicted by means of ultrasonography. Knowledge of the nerves precise location, which may evidence individual variations, may have useful clinical applications.

### 33

#### **1H-MR spectroscopy to evaluate intramuscular lipid changes in HIV + with lipodystrophy**

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**Purpose / Introduction:** Highly active antiretroviral therapy in HIV-infected patients frequently develop lipodystrophic syndrome, characterized by subcutaneous fat wasting and intra-abdominal, breast or dorsocervical accumulation, dyslipidemia, insulin resistance, and also intramyocellular lipid (IMCL) accumulation. 1H-MR spectroscopy (1H-MRS) has been succeeded in discriminating the IMCL and extramyocellular lipid (EMCL)

component, although only IMCL concentrations show adequate repeatability due to homogeneous distribution. Our aim was to study the lipid component in muscle in a group of HIV-infected patients with lipodystrophy and their changes with the lipoatrophy reversal after switching from thymidine analogues (TA) to tenofovir-DF (TDF) by 1H-MRS.

**Materials and Methods:** Single-voxel PRESS 1H-MRS in tibialis anterior and soleus muscles were performed in 28 HIV-infected patients with moderate and severe lipodystrophy syndrome on TA treatment and 10 HIV-negative volunteers, at the baseline and at 6 months, after the switch to TDF treatment in the patients. Data were analyzed by using LCMoel software with eddy current correction and water scaling. We compare metabolite IMCL peak at 1.3 ppm values in both groups and changes after 6 months, we evaluate body composition measurements (fat and lean mass and BMD-DEXA, and visceral and subcutaneous fat-CT image at L4) changes in the patients after switching to TDF and we correlated these changes with the IMCL metabolite concentrations, by U-Mann Whitney and Wilcoxon signed rank tests, and Spearman coefficient and binary correlations ( $P > 0.05$ ).

**Results:** As expected, patients 6 months after switching to TDF a significant peripheral and total fat content increased measured by DEXA ( $P = 0.0007$ ), although peripheral and total lean mass decreased significantly ( $P = 0.0004$ ). These findings were related with a decrease in IMCL in both muscles, although no significant. Patients presented higher IMCL than controls at the baseline in both muscles, and only changed to lower IMCL in tibialis anterior levels after 6 months, although no significant ( $P > 0.05$ ). Controls presented slight higher IMCL in muscle after 6 months, although no significant ( $P > 0.05$ ). We observed that the 55,17% (in soleus) and 62,07% (in tibialis anterior) of patients presented decrease of IMCL and peripheral lean mass, although significant correlation were not demonstrated ( $P > 0.05$ ).

**Discussion / Conclusion:** After switching from thymidine analogues to TDF leads to significant reversal of peripheral lipoatrophy, whereas lean mass decrease when measured by DEXA. Although no significant, a relation was observed between peripheral fat gain, loss of peripheral lean mass, and decrease of IMCL, which could reflect a migration of lipid content from intramyocellular to periphery.

### 34

#### **MRI of lumbar degenerative disc disease as predictor of clinical outcome following image guided lumbosacral selective nerve root block**

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**Purpose / Introduction:** To evaluate the predictive value of Lumbar MR image findings as a prognostic determinant of symptom resolution in patients undergoing lumbosacral spine Image Guided Selective Nerve Root Block [SNRB] in order to enhance appropriate patient selection.

**Materials and Methods:** Fifty consecutive patients referred with lumbosacral radicular pain were examined with MR imaging and treated with lumbosacral image guided Selective Nerve Root Block performed by a single radiologist between 2007 and 2008. Outcome was determined retrospectively and classified according to resolution of symptoms, partial resolution, or no change. Various lumbar MRI findings were analysed and graded according to severity. Factors included presence of spinal stenosis, extent of disc herniation and location of disc to nerve root. Pain relief was graded [0–100%] by using a visual analogue scale. Outcome was evaluated in relation to MRI findings and clinical symptoms and pain resolution using Mann-Whitney U tests.

**Results:** 21 injections at L4/L5 and 29 injections at L5/S1 were performed. Shorter duration of symptoms, absence of nerve root compression, capacious thecal sac, presence of disc extrusion and disc disease at the level of L5/S1 were associated with increased symptom resolution. Longer duration of symptoms, focal disc bulge and presence of nerve root compression were associated with incomplete resolution of symptoms.

**Discussion / Conclusion:** Preprocedural lumbar spine MRI is an effective predictive tool in determining which patients will benefit from image guided selective nerve root block of the lumbar spine

### 35

#### **Ultrasound assessment of intra-articular entrapment of the long head of biceps (hourglass biceps): a series of 16 surgically proven cases**

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**Purpose / Introduction:** The purpose of this study was to identify the pre-operative sonographic findings in entrapment of the long head of biceps (LHB), the so-called hourglass biceps lesion, with particular emphasis on dynamic assessment in this recently described entity.

**Materials and Methods:** A retrospective review of ultrasound imaging was performed for patients with surgically confirmed hourglass biceps lesions who had been treated at our teaching centre between 2003 and 2006. A series of 16 consecutive patients were included (six male, ten female) ranging in age from 45–77 years (mean, 67 years). Eight patients underwent routine ultrasound examination performed in a standardised fashion. In the

remaining eight patients the standard examination was supplemented by dynamic evaluation incorporating a novel technique to induce buckling of the intra-articular portion of the LHB tendon, a characteristic feature of the hourglass lesion.

**Results:** Standard ultrasound evaluation detected hypertrophy of the intra-articular portion of LHB in three out of eight patients (37.5%), however intra-articular buckling was not elicited in any of these patients. Of the eight patients undergoing supplemental dynamic assessment, intra-articular tendon hypertrophy was detected in six cases (75%) and intra-articular buckling was elicited in three of these six patients.

**Discussion / Conclusion:** From our early experience in evaluating the hourglass biceps dynamic ultrasound appears to hold promise and indeed our results would support a role for dynamic arm elevation manoeuvres in increasing diagnostic sensitivity of clinically suspected hourglass lesions of the biceps tendon.

### 36

#### **Cervical spinal canal dimensions**

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**Purpose / Introduction:** The aim of this study was to define normal values of the cervical spinal canal and spinal cord dimensions as a tool to quantify cervical spinal canal stenosis. In a large study sample, taking into consideration age and gender, we were able to examine the variability of the dimensions of the spinal canal and cord in healthy individuals. A standardized MRI protocol and evaluation form was used. The present study therefore was designed to provide a measure to adequately weigh the radiological findings in an equivocal clinical situation.

**Materials and Methods:** We examined 140 healthy volunteers, with an age range from 18–65 years (50% male, 50% female) using MRI. On T2 sagittal images the midsagittal diameters of the column of cerebrospinal fluid (measure of spinal canal width) and the cord were measured at the midvertebral level of C1, C3 and C6. At the same levels, from an axial reconstructed VIBE sequence, the area of the spinal cord and cerebrospinal fluid column were measured.

**Results:** The following means and interquartile ranges [IQR] were observed: The spinal canal width measured 15.60 mm [2,56] at C1 level, 13.03 mm [1,67] at C3 level and 12.88 mm [1,75] at C6 level. The area of the spinal canal measured 264.61 mm<sup>2</sup> [51,07] at C1 level, 190.91 mm<sup>2</sup> [30,90] at C3 level and 186.28 mm<sup>2</sup> [35,75] at C6 level. The spinal cord distance measured 8.34 mm [1,05] at C1 level, 7.66 mm [0,97] at C3 level and 7.10 mm



[0,61] at C6 level. The area of the spinal cord measured 72.87 mm<sup>2</sup> [11,65] at C1 level, 74.83 mm<sup>2</sup> [10,97] at C3 level and 73.87 mm<sup>2</sup> [10,57] at C6 level. Females had smaller values than men. With age the spinal canal distance widened at C1 and C3 levels, whereas at C6 level it decreased with age. Interestingly with older age, at the C1 level, the spinal canal width increased in females, but decreased in men.

**Discussion / Conclusion:** In conclusion the cervical spinal canal width and its spinal cord is dependent on the spinal level, the gender and the age of the person. Awareness of these aspects is important for adequate assessment of a spinal canal stenosis using MRI. This study was sponsored by SNF (#405340-104531).

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**MRI and radiographic findings after 10 years in patients with non-acute knee complaints; determination of risk for the development of osteoarthritis**

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**Purpose / Introduction:** The aim of this prospective follow-up study was to identify the significance of anterior cruciate ligament (ACL) and meniscus lesions as risk factors for knee osteoarthritis (OA). Structural abnormalities found at radiographs, MR and arthroscopy in a symptomatic population 10 years ago were correlated with present structural findings at knee radiography and MR.

**Materials and Methods:** Patients were retrieved from the database of a previous study on the impact of MRI guided treatment in 859 patients with sub-acute knee complaints. The mean follow-up was 10 years 0.90 (SD). A total of 326 patients (38%) were included. All participants had knee radiographs and 3.0 T MRI scans performed. Initial radiographs and MRI scans were compared with the follow-up radiographs and MR scans. Odds ratios with 95% confidence intervals were used to show associations between different risk factors and the presence of OA features 10 years later. All results were corrected for age, sex and body mass index.

**Results:** ACL ruptures - Radiographic findings in these patients showed an increased risk of joint space narrowing (JSN) in the medial tibiofemoral compartment (TFC). MRI showed an increased risk of cartilaginous lesions in the medial tibial condyle (MTC), and/or the lateral femoral (LFC) and/or lateral tibial condyle (LTC). Furthermore there was an increased risk of osteophytes on the medial femoral condyle (MFC) and/or MTC and/or LTC and an increased risk of bone marrow lesions (BML) and subchondral cysts (SC) in the LFC. Medial meniscus (MM) tears showed an increased risk of JSN and osteophytes in

the medial TFC on radiographs. MRI showed an increased risk of osteophytes in the MTC and BML in the MTC. Lateral meniscus (LM) tears showed an increased risk of JSN and osteophytes in the lateral TFC on radiographs. MRI findings included an increased risk of cartilaginous lesions in the LFC and/or LTC. Furthermore there was an increased risk of osteophytes in the LFC, and BML and SC in the LTC. All presented results were statistically significant.

**Discussion / Conclusion:** This follow-up study shows that after 10 years, meniscal tears and ACL ruptures have a strong correlation with the development of OA related radiographic and MRI features. These results confirm meniscus and ACL ruptures as significant risk factors in the development of OA.

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**3.0 T MR imaging of the knee meniscus: what about equivocal errors?**

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**Purpose / Introduction:** We undertook this retrospective study to assess the diagnostic performance of 3.0 T MRI in diagnosing meniscal tears of the knee using the One-Slice-Touch and the Two-Slice-Touch rule, as described in radiological literature.

**Materials and Methods:** Medical records of 65 patients who had 3.0 T MR examinations for internal knee derangement and subsequent arthroscopy were reviewed. MR images were interpreted by consensus by two reviewers and menisci were diagnosed as torn (meniscal abnormality on two or more images), possibly torn (meniscal abnormality on 1 image) or intact, using arthroscopy as the gold standard. Diagnostic performance of 3.0 T MRI for the medial and lateral meniscus was calculated using the One-Slice-Touch (considering all MRI diagnoses of a tear or possible tear as positive for a tear) and the Two-Slice-Touch (considering all MRI diagnoses of possible tear as negative for a tear) rules. Changes in accuracy using both methods were compared using the Fishers exact test ( $p < 0.05$ ). Furthermore, the area under the receiver operating characteristic curve (ROC) for the medial and lateral meniscus was determined.

**Results:** Considering all MRI diagnoses of a definite tear or possible tear as positive for a tear, sensitivity was 95% (40/42), specificity was 74% (17/23), positive and negative predictive values were 87% (40/46) and 89% (17/19), respectively, for the medial meniscus. For the lateral meniscus, sensitivity, specificity, positive and negative predictive values were 85% (11/13), 88% (46/52), 65% (11/17) and 96% (46/48), respectively. Considering only definite tears as positive for a tear (and probable tears as intact), sensitivity was 83% (35/42), specificity was 87%

(20/23), positive and negative predictive values were 92% (35/38) and 74% (20/27), respectively, for the medial meniscus. For the lateral meniscus, sensitivity, specificity, positive and negative predictive values were 77% (10/13), 92% (48/52), 71% (10/14) and 94% (48/51), respectively. None of these differences were statistically significant. Areas under the ROC curve for the medial and lateral meniscus were 0.89 and 0.88, respectively, which were also not significantly different.

**Discussion / Conclusion:** Although MRI of the knee performed at 3.0 T is accurate for the detection of both medial and lateral meniscal tears, MR diagnosis may remain difficult due to subtle findings that are equivocal for a tear, leading to a remarkable number of false positive and false negative findings, even at 3.0 T. We recommend that radiologists should rather be descriptive in reporting subtle or equivocal MR findings, alerting the clinician of possible meniscal tear.

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#### Dating fractures in children under 3 years

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**Purpose / Introduction:** This poster presents the results of a retrospective pilot study designed to determine how to establish robust criteria for fracture dating in children under three. This research is in response to the systematic review by the Welsh Child Protection Systematic Review Group (WCPSRG), looking for evidence for radiologic dating of fractures in children (Prosser, 2005). Following an all language literature search between 1966 and March 2004 they concluded that there is an urgent need to validate the criteria used in the radiologic dating of fractures in children younger than 5 years. Most abusive fractures occur in children younger than 3 years and 80% occur in children younger than 18 months. Radiologists are frequently asked to date fractures to aid the diagnosis of child abuse and to identify or exclude potential perpetrators.

**Materials and Methods:** We reviewed the x-rays of fractures in children and infants less than 3 years old, on the PACS imaging system at a UK University Hospital between May 2006 and October 2008. We excluded patients if they had a pre-existing illness or if there was uncertainty about the age or mechanism of the fracture. The images were assessed according to a list of potential fracture criteria based on published data and experience of the participating radiologists.

**Results:** 135 eligible fractures were identified, 14 in infants under 1 year old, and 67 under 2 years. The paediatric population base is 50 000 and the study period 30 months. We will present the age of the patient, the number of available follow-up films, the time since the fracture, the involved bone,

the type of fracture (displaced, angulated etc) and the presence of a cast. Fracture criteria will be assessed for value against the available images. Reference images will be provided.

**Discussion / Conclusion:** The absence of validated criteria for fracture dating in the age at risk of fractures from non-accidental injury has been highlighted by the WCPSRG. Our study illustrates the difficulty in obtaining valid criteria for fracture dating. In an endeavour to overcome these difficulties we will define, and demonstrate with reference images, the fracture criteria that we found useful in this age group. We will indicate the scale of the study required to validate any criteria and the difficulties that will be faced. We aim to use the results of this pilot study to underpin a larger multicentre study to establish an evidence base for fracture dating in this vulnerable age group.

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#### Lateral elbow tendinopathy: correlation of ultrasound findings with pain and functional disability.

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**Purpose / Introduction:** To assess the correlation between initial ultrasound findings and change in pain and functional disability in lateral elbow tendinopathy (lateral epicondylitis).

**Materials and Methods:** Sixty-two elbows (34 right, 28 left) in sixty-two patients (30 male, 32 female) with symptoms suggestive of lateral elbow tendinopathy underwent sonographic evaluation of the common extensor origin after initial assessment with a validated outcome measure. Sonographic technique was high frequency linear sonographic assessment of five criteria: hypoechogenicity, intrasubstance tears, lateral collateral ligament (LCL) tear, overall tendon thickness and neovascularity. The outcome measure used was the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire, a validated pain severity and functional disability scale, assessing pain; five questions graded 0-10, and functional disability; ten questions graded 0-10. The minimum score is 0 (no pain or disability) the maximum is 150 (severe pain and disability). After six months of conservative standardised treatment (physiotherapy with eccentric stretching) the PRTEE questionnaire was repeated. The correlation of initial ultrasound findings with change in outcome measure was assessed using linear regression (Prism 4, version 4.0c for Mac, GraphPad Software, San Diego, California, USA).

**Results:** The mean age of patients was 43 (range 25-61). Mean pre treatment PRTEE was 117 (range 77-146) and post treatment 43 (0-136). This difference in means was found to be significant ( $p < 0.0001$ ). 17 patients (27%) had little change in symptoms represented by a change in PRTEE of less than 40, mean change in PRTEE -74 (range

-137-30). A positive correlation was identified between post-treatment PRTEE and pre-treatment PRTEE ( $p < 0.05$ ), presence of LCL tear ( $p < 0.001$ ) and size of largest intrasubstance tear. A negative correlation was identified with amount of hypoechogenicity. No correlation was found with age, sex, side, duration of symptoms, thickness of tendon or amount of neovascularity.

**Discussion / Conclusion:** Lateral elbow tendinopathy is thought to be a degenerative, non-inflammatory process consistent with failed tendon healing. Although the ultrasound findings in lateral elbow tendinopathy have been well documented in previous studies few have correlation of findings with a validated outcome measure. This study shows that the most significant ultrasound features relating to a poor outcome are presence of LCL tear and the size of the largest intrasubstance tears. No correlation with tendon thickness or neovascularity is seen. This has implications not only for initial prognosis but also for treatment.

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##### **How do osteochondral defects at the donor site change after osteochondral transplantation; a long term follow up MR imaging study including a microscopy coil.**

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**Purpose / Introduction:** The purpose of the study was to evaluate cartilage and subchondral bone at the donor site after autologous osteochondral transplantation (OCT) over a 4 year time period using magnetic resonance imaging (MRI), and to evaluate the additional value of a microscopy coil.

**Materials and Methods:** Sixteen patients, mean age 32, 38% woman, underwent OCT for a focal osteochondral lesion in the femoral condyle. Donor sites were located at the lateral facet of the trochlea and were filled with osteoperiosteal plugs derived from the proximal tibia. A MRI of the knee was performed 3 months and 4 years after OCT. Knees were scanned using an acute knee protocol, including an axial balanced steady-state free precession (SSFP) sequence, on a 1.5 T scanner. In addition to the acute knee protocol a microscopy coil was used at the 4 year scan in seven patients, using a SSFP sequence. Cartilage defects, cartilage surface incongruity, cartilage signal intensity, cartilage overgrowth, bone marrow edema underneath graft, contour of bone underneath graft were assessed at the donor site.

**Results:** In all patients, the created cartilaginous and subchondral defects after OCT decreased in size over a 4 year time period. The donor site showed incorporation of the plugs in time in all patients. However, cartilage surface incongruity, cartilage signal intensity changes and an

irregular contour of bone underneath the graft remained in all patients. Bone marrow edema lesions disappeared in all patients. The additional microscopy coil used at the 4 year scan did not detect any extra lesions or did not lead to a different grading of the lesions. Also, the correct positioning of the microscopy coil was of variable quality and time consuming.

**Discussion / Conclusion:** The donor site showed incorporation of the plugs in time in all patients, BME disappeared in all patients. However, surface incongruity remained in all patients. The use of a microscopy-coil did not change the amount or grade of the lesions and is of limited value.

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##### **Ultrasound of the palmar flexor tendons: a review of methodology and findings following surgical repair**

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**Purpose / Introduction:** Injuries to the palmar flexor tendons occur due to deep laceration or acute avulsion. High Resolution Ultrasound (US) is useful in patients with poor clinical progress post tendon repair, or when tendon repair integrity is questioned. This pictorial review will assess the utility of US evaluation of Zone 1 and 2 flexor tendon repairs and correlate imaging findings with clinical measurements of progress.

**Materials and Methods:** Patients undergoing Adelaide 4-strand flexor tendon repairs attended for postoperative ultrasound evaluation of the injured digit. Each patient had participated in an early active mobilisation and protective splintage regime. Clinical assessments of tendon mobility and function were performed in each case (Strickland Score, [SS]: graded as Excellent, Good, Fair, Poor). High frequency (12 MHz) linear array ultrasound was used to attain still and real time cine loop images. Findings recorded included tendon thickness, repair integrity and vascularity at the repair site. Tendon mobility compared to uninjured normal digit, was assessed using a subjective grading system (1=Normal, 2=Slight Impairment, 3=Moderate Impairment, 4=Severe Impairment). Descriptive statistics including students t-test were performed.

**Results:** In total, eight Patients (Mean age 36, Range 20–68; 1F:7 M) were included, with 14 flexor tendon injuries. The repair site and surgical sutures were well visualized in all cases. In all 14 tendons, the repair site was intact. Mean tendon thickness at repair site was 0.35 mm (SD 0.066 mm) compared to 0.25 mm (SD 0.088) in the adjacent normal tendon ( $p = 0.001$ ). Increased vascularity at the repair site was seen in 14.3% ( $n = 2$ ) of cases. 60% of patients with good Strickland Score had tendon glide/mobility of normal or slight impairment (Grade 1 or 2), compared to only 25% of patients with fair Strickland

Score ( $p>0.05$ ). There was no significant association between tendon thickness and Strickland Score. Mean tendon thickness in patients with Good SS was 0.39 mm, compared to 0.33 mm in patients with Fair SS ( $p=0.2$ ). There was no significant difference in tendon thickness between partial and full thickness injuries.

**Discussion / Conclusion:** Ultrasound is a useful tool for non-invasive evaluation of flexor tendon outcomes, particularly real-time evaluation of tendon glide. Such findings may allow for more accurate tailoring of postoperative mobilization regimes.

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##### **CT perfusion can effectively monitor the effect of chemotherapy in patients with osteosarcoma**

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**Purpose / Introduction:** Osteosarcoma is the second common primary tumor of bones. This tumor is highly vascularized and often highly chemo-sensitive. Patients with osteosarcoma are often treated with chemotherapy before surgical solution. Such treatment can be easily monitored using CT perfusion.

**Materials and Methods:** CT perfusion has been used in 11 cases with osteosarcoma located in lower extremities. CT perfusion has been done before the start of chemotherapy and then after the finish 8–10 weeks later. The datasets have been processed separately and then compared with the other one on the same patient. Vanishing of vessels and change in perfusion maps in time was considered as high effect to chemotherapy treatment. No emphasis has been given to change in size of tumors.

**Results:** In six patients out of 11 CT perfusion maps revealed high sensitivity to osteosarcoma by given chemotherapy. After surgery treatment histological examinations revealed the same findings of sensitivity to chemotherapy. In five monitored patients CT perfusion showed partial or no sensitivity. This result was clearly confirmed by histological examination and in one patient also from necropsy.

**Discussion / Conclusion:** CT perfusion helps to monitor sensitivity to given chemotherapy in patients with osteosarcoma. There was high correlation between sensitivity of tumors to chemotherapy and histological findings there.

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##### **Image guided radiofrequency ablation of benign bone tumors**

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**Purpose / Introduction:** Radiofrequency ablation (RFA) has been established as a well-controlled and effective

alternative especially for the management of small self-limited bone tumors. In this study, the authors demonstrate the healing effect of RFA in cases of osteoid osteomas, chondroblastomas and osteoblastomas.

**Materials and Methods:** From 2003–2009 radiofrequency ablation was performed on 28 patients aged 11–44 years (mean: 24.4 years). Among them, 24 had osteoid osteomas, three had chondroblastomas and one had an osteoblastoma. All lesions were affecting the appendicular skeleton and their diameter ranged from 4 to 32 mm (mean: 10.4 mm). In the cases of chondroblastomas and osteoblastomas histologic diagnosis was available. Procedures were carried out under general or spinal anesthesia or conscious sedation, using a straight rigid monopolar RF electrode guided by CT or fluoroscopy. For larger lesions, two sessions of short time RF energy, in overlapping fields, were applied. Patients were followed up with imaging, and clinical evaluation. The clinical follow up period ranged from 2–60 months (mean: 22.7 mo).

**Results:** Technical success was achieved in 27/28 (96.4%) patients. However, technical failure happened in one osteoid osteoma patient due to subtle imaging appearance that was subsequently clarified with SPECT. Patients with large sized chondroblastomas and osteoblastoma experienced successful RFA sessions with excellent clinical response. Clinical success was obtained in 24 out of 28 patients (85.7%). Treatment failure was observed in four patients with osteoid osteomas (14.3%). Three of them end up with tolerable pain managed with medication and one was finally cured by surgical curettage. Complete pain relief was achieved in a mean time of 2 days and function without limitation was permitted (in respect of size and location) 7–45 days post RFA. One minor complication (thermal muscle injury) (3.5%) and two major /delayed complications (7.1%) (persistent post traumatic arthritis and purulent arthritis with cutaneous fistula surgically treated) occurred.

**Discussion / Conclusion:** The present study not only verifies the positive impact of RFA in the management of osteoid osteomas but also suggests that RFA, when correctly performed, could be included in the treatment algorithm of larger benign bone lesions, such as chondroblastomas and osteoblastomas.

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##### **Imaging diagnosis in differentiation of benign from malignant soft tissue musculoskeletal lesions**

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**Purpose / Introduction:** The purpose of this prospective study was to assess value of imaging diagnosis in differentiation of benign from malignant soft-tissue lesions, ability to make accurate preoperative staging and to make diagnostic algorithm for musculoskeletal lesions.



**Materials and Methods:** One hundred consecutive patients (53 male, 47 female, median age 51 years) with musculo-skeletal soft tissue mass underwent ultrasonography (US), computed tomography (CT) and magnetic resonance (MRI). Benign lesions were 70 (53 benign tumors and 17 tumor-like lesions) and 30 were malignant lesions (26 malignant tumors and four metastases). Fifteen MR imaging parameters were evaluated and also corresponding parameters on US and CT. The diagnosis was based on histopathologic findings from core needle biopsy and surgical specimens. Multivariate logistic regression analysis was used to identify the best combination of imaging parameters in used methods, predictive for malignancy.

**Results:** MRI compared to US and CT, had highest sensitivity 92,3%, specificity 87,8% and accuracy was 89% in predicting primary malignant soft tissue tumor. For benign tumors the accuracy was 94%. The correlation between imaging preoperative staging of malignant tumors was 63,6%. Following MRI parameters for predicting malignancy showed statistically significant difference ( $p < 0,01$ ): extracompartmental distribution, peritumoral edema, inhomogeneous SI in T2, peripheral and inhomogeneous contrast-enhancement.

**Discussion / Conclusion:** MRI had highest accuracy in imaging diagnosis of musculoskeletal lesions. A combination of individual parameters improved the differentiation between benign and malignant soft-tissue musculoskeletal lesions. Imaging diagnostic algorithm gives direction to evaluate musculoskeletal lesions in order not to make unnecessary examinations as well as not to miss malignant ones.

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#### Early sacroiliitis in patients with seronegative spondylarthritis : evaluation with dynamic contrast-enhanced magnetic resonance imaging

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**Purpose / Introduction:** To evaluate the degree of inflammation in early sacroiliitis in symptomatic patients with seronegative spondylarthritis (SpA) by dynamic contrast-enhanced magnetic resonance imaging.

**Materials and Methods:** 40 patients (25 male, 15 female, mean age 36,7 years) with inflammatory low back pain (IBP) were diagnosed as having seronegative spondylarthritis: 22 psoriatic arthritis, nine reactive arthritis, one arthritis associated with inflammatory bowel disease and 9 undifferentiated arthrites. IBP was defined according to the Calin criteria which require four of the five following manifestations: symptom onset before age 40, insidious onset, morning stiffness, persistence for at least three months, improvement with exercise. Patients could also be included if three of the five criteria were recorded plus

night pain. Back pain was graded on visual analogue 10-point scale (VAS) and disease duration was assessed. Magnetic resonance imaging was obtained with a 1.5 Tesla unit (Symphony Siemens, Germany) on coronal and axial plane, using the following sequences: short-tau inversion recovery, T1 and T2 weighted turbo spin echo, T2 weighted gradient echo with fat saturation. Finally was performed T1 weighted turbo spin echo sequence during contrast media administration (Gadobutrolo 0.1 mmol/kg) and then was calculated the enhancement factor at ROIs (regions of interest) in the joint space, in the joint capsule, in the subchondral bone and in the bone marrow. The grading of the MRI results was completed using an activity and chronicity index.

**Results:** In nine patients MRI did not demonstrate abnormalities in sacroiliac joints. Acute inflammation changes were present in 23 sacroiliac joints, most frequently located in bone marrow and/or subchondral bone, with prevalence of moderate grade. Structural changes as osseous sclerosis, erosions and new bone formation were found in 8 patients associated to acute inflammations reports.

**Discussion / Conclusion:** All MR sequences had equal efficacy in ascertaining osseous sclerosis, erosion, new bone formation, bony bridging and ankylosis. MR dynamic contrast-enhanced sequences allow optimal visualization and grading of active inflammatory changes in the subchondral bone, bone marrow as osteitis, synovitis and capsulitis in symptomatic patients with seronegative spondylarthritis (SpA).

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#### Can the quantitative MRI findings be used to predict the clinical outcome in patients undergoing ACL reconstruction operation?

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**Purpose / Introduction:** To compare and correlate the pre-operative quantitative MRI findings with the post-operative quantitative MRI findings and the (clinical) Cincinnati scores in patients with ACL rupture.

**Materials and Methods:** The ACL angle, PCL angle and the anterior tibial translation were measured in 12 patients with ACL rupture prior to and after the ACL reconstruction operation. After the operation a Cincinnati score was determined for each patient. Pre- and post-operative ACL angle, PCL angle, and the tibial translation value (in mm) were compared using Students paired t test. The correlations between the pre- and post-operative ACL angle, PCL angle, and the tibial translation value and the Cincinnati score were evaluated using the Pearson correlation. P-values smaller than 0.05 were accepted statistically significant.

**Results:** For the ACL angle, PCL angle, and tibial translation, the differences between the pre- and postoperative findings were statistically significantly different. There were statistically significant and strong negative correlation between pre-operative PCL angle and pre-operative tibial translation ( $r=-0.66$ ;  $p=0.02$ ), pre-operative tibial translation and post-operative Cincinnati score ( $r=0.71$ ;  $p=0.01$ ), and post-operative PCL angle and post-operative Cincinnati score ( $r=0.66$ ;  $p=0.02$ ).

**Discussion / Conclusion:** The differences in the pre- and post-operative quantitative MRI findings statistically significantly differ in patients with ACL rupture. Moreover, the quantitative MRI findings can be effectively used to predict the clinical outcome after the ACL reconstruction operation.

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##### **MRI of the knee at 3 T first clinical results with an isotropic PDfs-weighted 3D-TSE-sequence**

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**Purpose / Introduction:** 3D-TSE-sequences allow covering a whole organ of interest with an isotropic slab, facilitating interactive 3D-visualization. The high isotropic resolution reduces partial volume effects and enables free 3D-multiplanar-reformatting (MPR) without loss of image quality in the three major anatomical planes and along structures of interest. The purpose of this study was to technically and clinically evaluate knee-MRI at 3 T with an isotropic fat-saturated (FS) proton-density-weighted (PDw) 3D-TSE-sequence.

**Materials and Methods:** For technical evaluation the dominant knee of ten healthy volunteers was examined with the sagittally orientated PD-FS 3D-TSE-sequence SPACE (TR 1200 ms/TE 30 ms/voxel-size 0.53 mm<sup>3</sup>/acquisition-time 10:35 min) on a 3 T-scanner (Magnetom TRIO). 0.5, 1 and 2 mm thick multiplanar-reconstructions (MPRs) were performed in the three major anatomic planes. SNR, CNR, SNR-efficiency and anatomical-detail-visualization (5-point-scale) were compared to high-resolution state-of-the-art 2D-TSE-sequences in 3 orthogonal planes (TR 3200 ms/TE 30 ms/voxel-size 0.36 × 0.36 × 3 mm/total acquisition-time 12:34 min). Sixty patients with cartilage and meniscus pathologies were examined with the same techniques. Patient 3D-datasets were assessed using 1 mm-thick MPRs. Detection of abnormalities and diagnostic confidence were assessed by 2 radiologists independently. Arthroscopy correlation was available for 18 patients. Statistical analysis was performed using 95%-confidence intervals, Wilcoxon-signed-rank-tests and Weighted- $\kappa$ .

**Results:** SNR-efficiency of SPACE was four to five times higher than for 2D-TSE-sequences. SNR and CNR of 1 mm-thick SPACE-reconstructions were comparable to 2D-TSE-sequences and provided superior visualization of small structures such as meniscal root ligaments. Correlation with arthroscopy did not show significant differences between 2D- and 3D- sequences. One reader detected significantly more cartilage abnormalities with the 2D-TSE-sequence (131 vs. 151,  $p=0.04$ ). Diagnostic confidence was significantly higher for meniscus abnormalities for SPACE for one reader. Intersequence-correlation was excellent ( $\kappa=0.82-0.92$ ). Interreader-correlation was good to excellent ( $\kappa=0.71-0.80$ ), intrareader-correlation was excellent ( $\kappa=0.90$  to 0.92).

**Discussion / Conclusion:** 3 T enables time-efficient 3D-TSE-imaging of the knee at adequate SNR and CNR. Detection and visualization of meniscus- and cartilage-pathologies is at least comparable to state-of-the-art 2D-TSE-sequences. 3D-TSE-sequences with consecutive MPR may become a valuable component of future knee-MRI protocols.

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##### **Anatomical study of phrenic nerve using ultrasonography**

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**Purpose / Introduction:** The purpose of our study was to demonstrate that ultrasonography may allow a precise assessment of the course and relationships of the phrenic nerve in its cervical course.

**Materials and Methods:** This study, initially undertaken in five cadavers, was followed by high resolution ultrasonographic study in 20 volunteers (40 nerves) by two radiologists in consensus. The location, course and relationships to the adjacent anatomic structures of the phrenic nerve were analyzed.

**Results:** The precise course of the phrenic nerve could be identified by high resolution ultrasonography. Some useful anatomic landmarks for the detection of the nerve could be defined including the transverse cervical and the ascendant cervical arteries. Some anatomic variations could also be observed.

**Discussion / Conclusion:** The cervical course of the phrenic nerve can be identified by means of ultrasonography. Knowledge of the nerves precise location, which may evidence individual variations, may have useful clinical applications.

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##### **Image guided therapeutic steroid injection in groin pain. Correlation with pre procedural MRI and post procedural outcome**

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**Purpose / Introduction:** To determine the effect of symphyseal/adductor attachment image guided steroid injection in patients with groin pain and to correlate subsequent outcome with pre procedural appearance at MRI.

**Materials and Methods:** 47 patients with MRI proven groin injury referred for therapeutic symphyseal steroid injection were included for the study. In each case, record was made of duration of symptoms, response to the injection, rehabilitation technique and time to return to sport. In each case correlation was made with finding at pre procedural MRI in an attempt to identify imaging predictors of outcome.

**Results:** At 3 months 35 of 47 (74.4%) patients returned to sport without persistent groin pain. In 7 of 47 (14.8%) subjects returned to sport at 3 months with persistent groin discomfort. In 5 of 47 (10.6%) subjects symptoms persisted, in four cases requiring surgical intervention. In each of these cases note was made of florid osteitis pubis accompanying adductor dysfunction at pre procedural MRI.

**Discussion / Conclusion:** Image guided steroid injection is an effective treatment of groin injury in sportsmen, in this study leading to complete resolution at 3 months in 35 of 47 patients. The presence of pre procedural osteitis pubis with coexistent adductor dysfunction at pre procedural MRI is a predictor of poor outcome.

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### Effectiveness of conventional radiographs and CT in evaluating elbow stiffness

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**Purpose / Introduction:** To evaluate effectiveness of conventional radiographs and CT to explain cause of elbow stiffness and to predict restriction of motion.

**Materials and Methods:** Two independent radiologists analyzed conventional radiographs and CT in 94 consecutive patients (71 men, 23 women, mean age 41 years, range: 18–68 years) with elbow stiffness. Arthroscopic or surgical correlation was available in 62% (58/94) patients. Two readers had to detect loose bodies (dorsal and/or ventral) or osteophytes (dorsal, ventral, humeral, radial and/or ulnar) potentially explaining restriction of flexion and/or extension. Restrictive range of motion in flexion and extension was determined in degrees on each imaging method and compared with true restriction of motion measured by orthopedic surgeons. Accuracy was calculated for diagnosis of loose bodies, osteophytes and joint incongruity. Spearman-rank correlation was calculated between restrictive range of motion determined on images and restrictive range of motion measured clinically by orthopedic surgeons. For interobserver agreement kappa statistic was used.

**Results:** Accuracy for detecting loose bodies was 79% with CT, and 67% with conventional radiographs. Differences in accuracy were most pronounced for detecting loose bodies in dorsal aspect of joint (79% for CT vs. 64% for conventional radiographs). Accuracy for detecting osteophytes was 76% with CT, and 69% with conventional radiographs. Differences in accuracy were most pronounced for humeral osteophytes (76% CT vs. 65% conventional radiographs). Restriction of extension measurements on CT correlated significantly ( $R=0.28/0.27$ ,  $P=0.007/0.01$ ) with clinical restriction of motion. Restriction of flexion measurements by CT correlated significantly ( $R=0.21/0.17$ ,  $P=0.04/0.10$ ) with clinical restriction of motion only by one reader. Restriction measurements on conventional radiographs did not correlate significantly with clinical restriction ( $R=0.08-0.19$ ,  $P > 0.05$ ). Kappa values for interobserver agreement for CT varied between 0.76 and 0.83, and for conventional radiographs between 0.60 and 0.64.

**Discussion / Conclusion:** CT shows better accuracy than conventional radiographs for detecting loose bodies but also for osteophytes. Differences are most pronounced for abnormalities in the dorsal aspect of the joint. In contrast to conventional radiographs, CT allows to predict restrictive range of motion.

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### Outcome of ultrasound-guided aspiration and lavage in calcific tendinosis of the shoulder and other tendons

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**Purpose / Introduction:** To determine the effectiveness and complications of ultrasound-guided two-needle aspiration and lavage in the treatment of patients with calcific tendinosis of several different tendons by using radiographs, ultrasound scans (US) and clinical follow up.

**Materials and Methods:** A retrospective chart review was performed, 39 patients (13 male, 26 female) were identified to have received ultrasound guided aspiration and lavage of calcific tendinosis between 2004 and 2008. Radiographs before and after treatment (mean follow up period 12 weeks,  $SD\pm 9$ ) were evaluated by measuring the size of calcifications and by establishing the quality (solid vs. diffuse) of the calcification. Furthermore, an interview by telephone for pre- and post-treatment assessment of pain and tendon function by using a numeric rating scale (0=no pain to 10=maximal pain), and patient satisfaction score served as outcome measures. Complications (tendon tears, infection) were evaluated on US images, clinical history and by phone interview.

**Results:** Thirty supra/infra-spinatus tendons, four subscapularis tendons, one common extensor tendon, one com-

mon flexor tendon, one triceps tendon, one patellar tendon and one biceps tendon of the thigh underwent US guided aspiration and lavage during this period. On radiographs 38% of calcifications showed a reduction in area of the calcification by 80–100%, while 31% of the cases showed a reduction of 60–79%. In all these cases good clinical outcome without complications was observed (pain < 3). In 16% a resolution of 0, 19% was found, correlating to poor clinical improvement. All non-shoulder patients have shown good improvement after treatment.

**Discussion / Conclusion:** Ultrasound guided aspiration and lavage is an effective treatment for rotator cuff calcifications as well as for other tendons. No increased complication rate was detected using the classical two needle technique. It was shown that when a partial resolution (> 60%) of the calcification was observed on radiographs, improvement resulted. Thus, radiographic findings corresponded well to clinical assessments.

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#### Quantitative analysis of MRI perfusion parameters in healthy and pathologic bone marrow: initial results.

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**Purpose / Introduction:** Previous studies using dynamic contrast-enhanced MRI (DCE-MRI) in the spine are based on qualitative, descriptive signal parameters. The purpose of this study was to evaluate the potential of a new method for direct measurement of perfusion and endothelial permeability in bone marrow using high temporal resolution DCE-MRI.

**Materials and Methods:** A total of 30 patients were measured on a 1.5 Tesla-scanner. The protocol included sagittal pre-contrast sequences for morphological evaluation of focal lesions. DCE-MRI was performed with a 2D-saturation-recovery Turbo-Flash sequence, measuring 4 slices per second for 5 min. ROI's were defined manually inside the aorta to measure the arterial input function (AIF), in the lesion and in two healthy vertebrae. A two-compartment model was fitted to the concentration-time curves, producing three independent parameters: the plasma flow (PF), plasma volume (PV) and permeability-surface product (PS).

**Results:** Malignant lesions ( $n=16$ ) included metastasis and/or pathologic fracture, benign lesions ( $n=14$ ) included osteoporotic fracture, spondylodiscitis, erosive osteochondrosis and hemangioma. Quantitative perfusion parameters in healthy marrow were PF=11,63±4,84 ml/min, PV 4,30±2,73 ml and PS -0,04±0,07 ml/min. Significant differences were found in pathologic lesions for all parameters, precisely PF 124±149 ml/min ( $p<0,05$ ; t-test), PV 21±11 ml ( $p<0,001$ ) and PS 5±3,7 ml/min ( $p<0,001$ ).

**Discussion / Conclusion:** Quantitative perfusion parameters in healthy bone marrow are reproducible and consistent. Significant differences with pathologic bone marrow indicate the potential for lesion detection. The potential for lesion characterization remains to be determined in a larger population.

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#### Diffusion weighted MR imaging in the diagnosis of vertebral metastasis in patients known primary malignancy

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**Purpose / Introduction:** This study aims to evaluate the use of single shot echo planar diffusion weighted MR imaging (DWSSEPI) in the diagnosis of vertebral metastasis in patients who have known primary malignancy.

**Materials and Methods:** Forty patients (65,5+8,21 (55–85) years, 11 female, 29 male) with known primary malignancy proved by biopsy were recruited to the study. Of these 22/ 40 patients were displayed by STIR MRI, which is used as a reference test, to have metastasis in totally 188 vertebra. Diffusion-weighted images (DW) were obtained by (DWSSEPI) with diffusion gradient ( $b=600$  sn/mm<sup>2</sup> TR: 7500 msn, TE: 82,2 msn,) using a 1.5 T MR scanner (GE Healthcare, Milwaukee, WI), (STIR images. ADC values were evaluated in 188 lesions and measured by using ADC mapping All patient were undergo whole body bone scintigraphy and the results were correlated with STIR, DWSSEPI and ADC findings.

**Results:** Metastatic vertebra shown by DWSSEPI images as high signal intensity in 167 / 188 vertebra (88%) , in 22 / 40 patients (100%). DWSSEPI has revealed high sensitivity: 88%, specificity: 96,9% and PPR 87,5%. of these 183 / shown to have a 188 (97%) metastatic vertebra has a significant statistical high ADC values compared with apparently normal vertebra ( $p<0.05$ ) . DWSSEPI was found to be highly specific in the diagnosis of osteoblastic metastatic tumor infiltration of spine (sensitivity 81%, specificity 96% and PPR 87,4%). On the other hand, ADC values were statistically significant in determining osteoblastic metastasis ( $p<0.05$ ). Whole body bone scintigraphy could demonstrate 167 / 188 metastatic vertebra in 21/40 patients.

**Discussion / Conclusion:** DWSSEPI of spine is a useful technique to demonstrate vertebral metastasis.

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#### MRI imaging findings in early stage breast cancer patients treated with aromatase inhibitors developing AI-associated arthralgia syndrome

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**Purpose / Introduction:** Third generation aromatase inhibitors (AIs) are now recommended as the preferred therapy for hormone-receptor-positive early breast cancer. Patients treated with AIs have a higher incidence of arthralgia, skeletal and muscle pain, clinically described as AI-associated arthralgia syndrome. It is important for radiologists to know and understand the radiological manifestations of AI induced arthralgia since its incidence will only increase with the increasing use of these medications.

**Materials and Methods:** We present the radiological findings of postmenopausal women under treatment with third generation aromatase inhibitors for early stage breast cancer developing AI-associated arthralgia syndrome in wrists and hands. A radiological evaluation of the hand and wrist joints were performed using magnetic resonance imaging. The patients had a baseline MRI before the start of the treatment and an MRI after 6 months. 11 patients developed arthralgia and myalgias of the hands and wrists most often presenting as severe morning stiffness. Their radiological examinations obtained after 6 months were compared with the baseline examinations withholding only the de-novo or increased radiological abnormalities induced by the AIs.

**Results:** Both hands were affected in all patients. The radiological findings produced by the AIs were; distension of tendon sheath due to fluid, mild or moderate swollen tendon indicating tendinosis, hyperemia of the synovial sheath with contrast captation, edema of the surrounding tissue and synovitis of nearby joints. Although the patient may experience severe clinical complaints, the radiological changes are often subtle. Therefore, baseline examination at the start of therapy is very useful in detecting the subtle changes.

**Discussion / Conclusion:** Arthralgia and skeletal and muscle pain are frequently associated with AIs of the third generation. This AI-associated arthralgia syndrome can substantially impact quality of life, and occasionally lead to early discontinuation of AI therapy. We showed the radiological signs and changes in patients suffering from AI-associated arthralgia in hands and wrists by comparing the radiological findings before the start of the treatment and the imaging findings after 6 months. These radiological changes are subtle and include fluid in the tendon sheath, contrast captation of the synovial sheath, tendinosis, edema of the surrounding tissue and synovitis of the nearby joints.

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### Suprolateral Hoffa fat pad impingement- distinct entity or an incidentaloma?

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**Purpose / Introduction:** Edema within the superolateral Hoffa's fat pad (SLHE) on knee MRI has been described in femoro-patellar impingement syndrome in patients with anterior knee pain. However, its association with other abnormalities in the knee and in various age groups has not been evaluated. We hypothesized that Hoffa's fat pad impingement is not a specific entity in itself but fat pad edema at this location is a manifestation of increased stresses within the knee. The purpose was to study the incidence of SLHE, its correlation with clinical symptoms, particularly when an isolated abnormality, and association with extensor and other internal knee derangement.

**Materials and Methods:** A retrospective review of 400 knee MRI exams (0.5-3 T systems), reported by three musculoskeletal radiologists was performed. Of these, 43 patients (M: F=18:25; age 11 to 58 y) had abnormal SLHE on fat suppressed axial and sagittal images in the superolateral Hoffa's fat pad. These were divided into three groups, A: associated extensor mechanism changes, B: other internal derangements, C: isolated SLHE. Review of the reports and evaluation of the clinical history was then performed.

**Results:** 43/400 MRI scans were positive for SLHE, 11% incidence, M: F=42%:58%. Age distribution: less than 20 years (18.7%), 21–40 years (6.8%), 41–60 years (9%). Group A 51% (22), Group B 32.5% (14), and Group C isolated SLHE in 16.3% (7). Of Group A: 33% (14) patients had patella alta, patellar subluxation or bipartite patella, 18.6% (8) patients had patellar tendinosis, patellofemoral osteoarthritis, pre-femoral/ quadriceps fat pad edema. Of Group B: meniscal tears (5), ACL (4), MCL (2); fractures (2) and bone marrow contusion (1). In 84% (36/43) patients there other mechanical stress related to patients activities or occupation. Clinically, the pain was localized to the anterior/ anterolateral knee in only 14% (6/43) patients. Of these only 7% (3/43) had isolated SLHE.

**Discussion / Conclusion:** Hoffa's fat pad edema is seen in 11% of patients referred for knee MRI. It is a poor localizing sign with the majority of patients presenting with pain away from this location. However, it does signify the presence of extensor mechanism abnormalities. It is likely incidental only when there are other causes of internal joint derangement which result in altered mechanics of the knee. Overall, rather than specific impingement SLHE reflects altered stress in the joint.

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### Advanced 3 T MRI of upper extremity nerves

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**Purpose / Introduction:** This study aims to evaluate the potential of 3 T MRI and advanced MR imaging techniques

(diffusion tensor imaging DTI and tractography, conventional and chemical shift sensitive sequences) in the assessment of upper extremity nerve (UEN) anatomy and pathology

**Materials and Methods:** After clinical and electrophysiological localization of upper nerve injury, six patients with carpal tunnel syndrome (CTS, one right sided, one left sided), radial nerve palsy (RNP,  $n=1$ ), suspect traumatic ulnar nerve injury ( $n=1$ ), sulcus ulnaris syndrome (SUS,  $n=1$ ), brachial plexus neurofibroma ( $n=1$ ), four normal controls and two formalin-fixed anatomical upper extremity specimen (male and female) underwent 3 T MR imaging. A regionally matched axial echo-planar single shot DT weighted sequence ( $b=0/400$  and  $0/700$ , FOV(mm)= $160 \times 160 \times 112$ , matrix  $64 \times 64$ , 6/32 diffusion encoding directions) was coregistered with coronal and axial STIR and T2-weighted sequences. After multiple axial regions of interest were defined along the median, ulnar and radial nerve, tractography was performed and FA, ADC and eigenvalues of the calculated trajectories were measured. Moreover chemical shift sensitive in- and opposed phase sequences were acquired in both cadaveric specimen as well as in normal controls.

**Results:** In all subjects three dimensional (3D) visualization of segments of the median, ulnar, radial nerve and of the brachial plexus (ventral and dorsal roots, trunci and fascicles) was successful. The median nerve could be 3D followed to the transverse carpal ligament, where it appeared disrupted and dispersed with reduced FA values and primary eigenvalues in CTS. Spindle shaped thickening of the radial nerve was found in RNP, with only few trajectories passing through the lesion, leading to the diagnosis of traumatic nerve neuroma. By the 3D visualization of the brachial plexus nerve roots and the topographical relation to a neurofibroma, tractography was helpful in preoperative surgical planning. According to the loss of free diffusible water, DTI was only partly feasible in the depiction of the median nerve in both formalin-fixed anatomical specimen.

**Discussion / Conclusion:** Using 3 T MR imaging segments of UEN is feasible in the two- and three-dimensional visualization of upper extremity nerves. DTI promises to further characterize the nerve microstructure in pathological and physiological conditions. Tractography provides a 3D impression of UEN segments and can aid in the preoperative surgical planning of various nerve pathologies.

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### Effects of unloading and compression on T1-Gd (dGEMRIC) relaxation times in healthy articular knee cartilage: in vivo effects at 3 Tesla

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**Purpose / Introduction:** To determine the effects of unloading and compression on T1-Gd relaxation times (dGEMRIC technique) in healthy articular knee cartilage in vivo.

**Materials and Methods:** We enrolled ten healthy volunteers (age range, 22–31 years) in our study. dGEMRIC images of the volunteers right knee joints were obtained using a 3.0 T MR scanner, equipped with a dedicated, 8-channel knee array coil. Images were acquired (1) 90 min after injection of 0.2 mmol/kg of Gd-DTPA<sup>2-</sup>, including 20 min of exercise (baseline); (2) 20 min after unloading (unloading); and (3) during application of a compressive force (50% of the body weight), generated by a loading device via a footplate (compression). T1-Gd values were assessed for seven cartilage zones: anterior, central, posterior, and dorsal femoral; and anterior, central, and posterior tibial. Three-way ANOVA with random effects were used for all group comparisons.

**Results:** A significant mean decrease of T1-Gd relaxation times of 56.6 ms was observed from baseline and compression ( $p<0.001$ ), and also a significant mean decrease of 42.1 ms from unloading and compression ( $p<0.001$ ). There was no significant difference of T1-Gd times between baseline and unloading. T1-Gd values were higher in the cartilage contact zone (central femoral and tibial zones) than in the non-contact zone (anterior and posterior femoral and tibial zones, and dorsal femoral zone), with mean relaxation times of 698.3 and 662.9, respectively ( $p<0.01$ ).

**Discussion / Conclusion:** In vivo, physiological cartilage stress decreases the T1-Gd relaxation times of healthy articular knee cartilage by about 50 ms, which is equivalent to a decrease in the glycosaminoglycan (GAG) content. This T1-Gd decrease of approximately 50 ms may, possibly, represent a useful dynamic reference value for the detection of cartilage disease.

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### Plantar fascia injections: Does technique matter?

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**Purpose / Introduction:** To evaluate patient satisfaction and relief of symptoms from plantar fasciitis after ultrasound guided steroid injection.

**Materials and Methods:** All patients attending the musculoskeletal radiology department for ultrasound-guided plantar fascia injections during a 12 month period (January 2007 January 2008) were included in the study. A questionnaire was sent out asking patients to rate their pain

before, during, 3 and 12 months after the injection. Level of pain was recorded using a 5 point Likert scale. Patients were asked to comment on whether they felt the injection had improved their symptoms and to note any procedural complications experienced. Details of the radiologist who had performed the procedure and whether they used a dry-needling technique were recorded.

**Results:** 31 patients received injections over the 12 month period; no patients were excluded from the study. A 93% (28/30) response rate was achieved. 89% rated their initial pain as a 4 or 5. Immediately after the injection 64% (18/28) felt their pain has decreased to 2 or below; 3 months post injection this level increased to 70%. 12 months later, 78% felt that their pain had not returned (1–2). 96% (27/28) believed they had had an improvement in symptoms after injection and would recommend the procedure to someone else. There was no statistically significant difference between techniques used and no post procedural complications.

**Discussion / Conclusion:** Ultrasound-guided steroid injection offers a safe, effective treatment of plantar fasciitis, regardless of technique used.

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### The role of contrast-enhanced MRI in the evaluation of the revascularization process of the anterior cruciate ligament graft

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**Purpose / Introduction:** The revascularization of the Anterior Cruciate Ligament (ACL) graft is a critical phase during its healing progress that determines the functional outcome for the knee. The purpose of this study is to compare the revascularization status of the intrarticular and intraosseous part of the ACL graft 6 and 9 months after arthroscopic ACL reconstruction and correlate these findings with results from clinical examination.

**Materials and Methods:** Twenty six patients (mean age 25 years) who underwent arthroscopic ACL reconstruction with bone-patellar tendon-bone autografts were evaluated with contrast-enhanced MRI 6 and 9 months (group 1 and 2 respectively) after surgery. Three-dimensional spoiled gradient echo sequences with fat suppression were obtained before and after intravenous administration of gadolinium contrast agent (CA). A region of interest was assigned and the signal/noise quotient (SNQ) was calculated by dividing the signal intensity of the graft to the signal intensity of the background at three specific sites of the graft (intraarticular-site 1, tibial tunnel-site 2 and juxtascREW-site 3) before and after CA administration. Comparisons of the enhancement index (SNQ after / SNQ before CA) from the three sites between the two

groups and within each group were performed using t-test. All patients were clinically examined with arthrometric tests as well as Lysholm, Tegner activity and International Knee Documentation Committee (IKDC) scores.

**Results:** The mean values of enhancement index were 1,52 (S.D:0,27), 1,32 (S.D:0,32) and 1,22 (S.D:0,11) for sites 1, 2 and 3 respectively in group 1 and 1,53 (S.D: 0,39), 1,42 (S.D: 0,23) and 1,39 (S.D: 0,52) for sites 1, 2 and 3 respectively in group 2. The comparison of each of the above values showed non significant differences between the two groups. Non significant differences were also found regarding the enhancement index within each group in all three sites of measurements. Clinical examination revealed that joint stability was regained in all cases.

**Discussion / Conclusion:** At 6 months there is a full revascularization of the graft which remains until 9 months. Our findings are strongly indicative of an early ACL revascularization within its whole length. Contrast-enhanced MRI in combination with clinical examination provides valuable information for the progress of the healing process.

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### Tenosynovial giant cell tumors of the hand: MRI findings

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**Purpose / Introduction:** Giant cell tumor of the tendon sheath (GCTTS) is an uncommon lesion with an estimated incidence of 1 in 50 000. It is thought to arise from the synovium of tendon sheaths. We aim to review and present the MRI findings of nine patients with histopathologically proved GCTTS accompanying with the literature knowledges.

**Materials and Methods:** Between 2006 and 2008 at ages between 16 and 54, five females, one males total six patients with painless palpabl mass and were examined with MRI

**Results:** At the MRI examination three of nine lesions were located at first phalanx of the left hand , one of nine lesions were located at second phalanx of the left hand, one of nine lesions were located at fifth phalanx of left hand, three of nine lesions were located at second phalanx of the right hand and last one was located at the right hand metacarpal. Seven of nine lesions were adjacent to flexor tendon, and two of nine lesions were adjacent to extensor tendon .MR signal intensities were on T1 weighted images equal to skeletal muscle, on T2 weighted images heterogeneous signal intensity. The lesions typically enhances after intravenous injection of gadolinium. These masses surgically removed and histopathologically confirmed compatible with GCTTS.

**Discussion / Conclusion:** GCTTS is the second most common tumors of the soft tissues in the hand. These

tumors are primarily found in adults 30–50 years of age. Most often the tumor is seen as a solitary nodule close to a tendon sheath on the palmar aspect of the first three fingers. The patient complains of a painless mass in almost every instance. The tendon sheath of the flexor digitorum tendons is usually partially or totally enveloped. The extensor tendons are less commonly involved. Surgery is mandatory and local recurrences may occur in as many as 30 % of cases. In conclusion, if there is small round mass of flexor or extensor surface of the hand, we should suspect GCTTS. After excision of this tumor, a long term follow up should be done to detect recurrent tumor.

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### T2 relaxation time of matrix-based autologous chondrocyte implantations A 2 years follow-up

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**Purpose / Introduction:** One recent cartilage repair technique for large defects is the matrix-associated autologous chondrocyte implantations (MACI). Follow-ups are usually conducted by conventional MRI. A promising MRI technique is the T2 relaxation time, which is correlated to water content and collagenous architecture of cartilage. Thus T2 carries information about the architecture of cartilage and might provide a potential tool for monitoring rehabilitational changes in MACI. As initial experiences are currently only available from cross-sectional studies, this first prospective longitudinal study was conducted for analysis of T2 evolution within MACI and the cartilage in the other compartments of the operated knee.

**Materials and Methods:** Ten patients after MACI (six femur, four patella) underwent MRI of their operated knee after 3 month, 6 month, 1 year and 2 years at 1.5 T (Magnetom Sonata, Siemens Medical, Erlangen) using a fat-saturated multislice-multiecho sequence (TR 3000 ms/TE 13.2 ms/8 echoes/resolution  $0.6^2 \times 3\text{mm}^3$ ). After data acquisition T2 maps were calculated pixel-wise using the Marquard-Levenstein-algorithm (exponential fit) for MACI, the opposing cartilage (oppCart), as well as the contralateral healthy cartilage plates (conCart). For each cartilage plate global T2 (average T2 value of complete lesion/healthy area) and regional T2 (T2 value after division into superficial/deep layer) were calculated. Statistics were performed using the Wilcoxon test (SPSS release 15.0.1 for Windows).

**Results:** Average global T2 (3mo/6mo/1y/2y) was 49/44/40/33 ms for MACI, 37/34/33/32 ms for oppCart, 35/34/33/32 ms and 32/32/32/30 ms for the corresponding conCart. There was a significant difference in T2 of MACI to the healthy cartilage up to 1y ( $p < 0.003$ ), none after 2y.

Longitudinal T2 decline was significant for MACI (6mo-2y 14.6%,  $p < 0.007$ ). Regional T2 values revealed that MACI lacked zonal differentiation even after 2y. Tendency for transient postoperative T2 time changes was seen in the cartilage opposite to MACI (3mo-1y,  $p < 0.06$ ; 3mo-2y,  $p < 0.006$ ). This was not observed in the healthy, non-operated, compartment.

**Discussion / Conclusion:** T2 is capable of depicting the continuous cartilage graft remodelling after MACI and supports clinical experience of remodelling process duration for at least 1-2y before reaching normal preoperative T2 values. Missing zonal differentiation within MACI might be due to the matrix-associated technique or to unfinished remodelling. Transient T2 elevation in the cartilage opposite to MACI might be due to postoperative trauma or adaptive postoperative biomechanical loading in the joint. Recapitulatory T2 provides a promising tool for postoperative follow-up examinations of cartilage repair.

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### Is ultrasound guided autologous blood injection an effective treatment for hamstring enthesopathy?

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**Purpose / Introduction:** To assess ultrasound guided autologous blood injection as an effective treatment for hamstring enthesopathy. Enthesopathy affecting the hamstring origins is a common debilitating clinical dilemma especially in the younger and athletic population. It is now generally accepted that tendinosis is not simple inflammatory response but an angiofibroblastic response secondary to repetitive microtrauma. Autologous blood injection (ABI) is a new and, until recently, poorly studied technique as an alternative to steroid injection therapy. It is believed that by introducing an individual's own blood into an area of inflammation this initiates subsequent healing in an otherwise degenerative process. To our knowledge, the efficacy of ABI therapy has not been investigated in the treatment of hamstring enthesopathy.

**Materials and Methods:** 42 patients with clinical suspicion of hamstring enthesopathy or partial tearing underwent ultrasound examination. All patients also had MRI correlation. When enthesopathy of the hamstring origin or a longitudinal interstitial tear was sonographically evident, the patient was prospectively enrolled in the study. Individuals were randomised into three groups; the first group (8 M, 6F, mean age 30) received 3 mL of Bupivacaine and 40 mg triamcinolone into the region of pathology. The second group (6 M, 8F, mean age 32) received 3 mL of Bupivacaine as well as an autologous blood injection into the site of enthesopathy / fibrillar discontinuity. The third group (8 M, 6F, mean age 34)



received 3 mL of Bupivacaine, 40 mg triamcinolone as well as blood. One injection was received by each patient. All patients also underwent a 6 week structured program of physiotherapy 3 weeks after the injection. A specially designed 'patient-related hamstring enthesopathy evaluation score' was used to determine the effect of each injection therapy on improvement of pain scores and function.

**Results:** Pre-procedural enthesopathy and pain scores were recorded with follow-up to 12 months post-procedure. The average functional score pre-injection was 73.7 in group 1, 75.3 in group 2 and 81.2 in group 3. This reduced significantly over a 3 week period in the steroid group but only lasted on average for 12 weeks increasing to 54.5 at 1 year. In the group given blood alone, the functional score remained lower (28.2) even at 12 months. The most significant reduction in pain score and most sustained functional improvement was seen in steroid and blood group (17.5 at 12 months).

**Discussion / Conclusion:** ABI given in combination with local steroid appears to be a more clinically effective alternative to steroid or dry-needling therapy alone. It is safe with no reports of complications.

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### Patterns of bone and muscle injury after high risk vaginal delivery compared to caesarian section

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**Purpose / Introduction:** By using typical musculoskeletal MR imaging to better define pubic bone changes and levator ani muscle injury arising from childbirth, especially comparing vaginal delivery and caesarian section.

**Materials and Methods:** In this on going study 36 primiparous postpartum women have been enrolled, 20 with vaginal delivery factors associated with pelvic floor damage and 12 with C-section. All were imaged at 4–6 weeks, 17 have had 6–7 month follow up imaging, 15 are awaiting follow-up,

4 dropped. MR was a 3 T with cardiac coil, intermediate and intermediate with fat saturation sequences, 4 mm and 2 mm sections. Bone marrow edema, fractures and muscle tears were graded as to location, extent and severity.

**Results:** Bone marrow edema was present in 27/32 women (13/20 vaginal, 10/12 C-section) initially, all decreased or resolved on follow-up. For vaginal delivery all foci were at or near insertion of levator ani muscles along posterior inferior pubic cortex and pubic symphysis. Most were focal and moderate to intense (4/20 unilateral, 9/20 asymmetrical). Only 2/10 C-section had moderate signal, and most were mild, diffuse and anterior in the pubic bone or along the pubic symphysis. Fractures larger than 5 mm were seen in 10/32 (9/20 vaginal (1 bilateral), 1/12 C-section), all had marrow edema and were at or near pubic symphysis, especially the posterior portion. All were focal but two, a displaced fracture extended into the inferior pubic ramus and a displaced para-symphyseal fracture. Seven women with fractures had bilateral muscle tears, five with contralateral higher grade tears. Fractures without tears were seen in two vaginal and 1 C-section.

Muscle tears were seen in 10/32 (10/20 vaginal, 0/12 C-section) and associated with marrow edema and fracture except in two cases. All tears involved the at least the anterior pubic portion of levator ani muscle. One woman had complete bilateral tears at the vagina repaired at delivery, another's tear extended into rectum and lateral levator ani fibers, also repaired at delivery.

**Discussion / Conclusion:** Two trauma patterns are seen in at risk women. Vaginal delivery has focal, intense bone marrow edema at or near the levator ani insertion on posterior inferior pubic cortex, often associated with anterior levator ani muscle tears and small fractures into the pubic symphysis. C-section has diffuse, mild, bilateral bone marrow edema with more anterior pubic location, no muscle tears and occasional fracture.