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ABSTRACTS OF PAPERS FOR FULL MEMBERSHIP

BONE AND JOINTS

MR imaging of the spine and sacroiliac joints in spondylarthropathy: tips, tricks and pitfalls

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Purpose: To translate the existing knowledge of MR imaging in spondylarthropathy into easy-to-use recommendations concerning imaging technique and image interpretation, applicable in daily clinical practice.

Approach: A concise review of the current literature is presented, illustrated by images obtained from our own database. The results of a comprehensive retrospective study that was performed at our own institution is discussed, and the practical implications of these results are highlighted.

Findings: According to the new classification criteria for axial spondylarthropathy developed by the "Assessment of SpondyloArthritis international Society (ASAS)", MR imaging of the sacroiliac joints plays a huge role in the early diagnosis of spondylarthropathy. MRI may show active and structural lesions. Active changes include bone marrow oedema, enthesitis, synovitis and capsulitis. Structural changes include fat deposition, sclerosis, erosions and ankylosis. The presence of bone marrow oedema is a key feature for the diagnosis of sacroillitis at MR imaging. Other active changes and structural changes are suggestive but do not suffice for the definition of a positive MRI.

MRI findings in sacroillitis have to be differentiated from findings that can have similar appearance but are non pathologic in nature. Coil artefacts can enhance the signal intensity at the posterior parts of the sacroiliac joints. Normal variants of the anatomy of the sacroiliac joint should not be confused with pathology. Normal vasculature in the sacroiliac joint has to be differentiated from small but relevant minimal bone marrow oedema.

Non-inflammatory disease can mimic the inflammatory type back pain in patients suspected of spondylarthropathy. These entities have to be actively looked for on MRI of the sacroiliac joints and reported if present.

A dedicated imaging protocol is mandatory to allow correct interpretation and diagnosis. For the spine, sagittal T1 and STIR images are the key sequences. For the sacroiliac joints, semicoronal T1 and STIR imaging is generally accepted as optimal imaging technique, but additional axial images of the pelvis are highly recommended, as they may demonstrate some anatomic variants and non-inflammatory changes that remain undetected if only semicoronal images are obtained.

Conclusion: Imaging plays a key role for the diagnosis of spondylarthropathy. It is very important not to overdiagnose spondylarthropathy as its treatment may be potentially harmful. Therefore a dedicated imaging technique is necessary and radiologists should be familiar with the findings in spondylarthropathy, the differential diagnosis and pitfalls of findings both in the spine and the sacroiliac joints.

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Cone Beam Computed Tomography: technical aspects and clinical applications in musculoskeletal imaging

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Learning objectives: In the past decade, Cone Beam Computed Tomography (CBCT) has become the standard imaging modality in dental radiology due to its high spatial resolution and low radiation dose.

On the contrary, musculoskeletal applications of CBCT are only scarcely reported, despite the major advantage of high spatial resolution when imaging small osseous structures.

The purpose of this pictorial review is twofold: (1) to give a short review of technical aspects of CBCT (including radiation dose), and (2) to illustrate the additional value of CBCT in frequently encountered musculoskeletal pathologies.

Materials and methods: The material is mainly culled from an ongoing comparative study between direct digital radiography of peripheral joints (elbow, wrist, hand-fingers, ankle, feet-toes and knees) and CBCT of patients referred for acute trauma.

In addition, CBCT was done for patients presenting with non acute pain as additional method to plain films or MRI in order to obtain a more specific diagnosis. In all cases, informed consent was given by the patient and the study was approved by the ethical committee of our institution.

During the period June 1, 2013-November 15, 2013, a total number of 289 musculoskeletal CBCT examinations were performed.

Discussion:

Technical aspects of CBCT: In CBCT, a cone-shaped ray beam makes a single rotation around the patient and is projected on a flat panel detector (FPD), unlike conventional Multi Detector CT (MDCT) where a fan shaped beam and concave detector rotate in a helical fashion.

The major advantage of CBCT is the high spatial resolution of the images, acquired at lower radiation doses than MDCT-studies.

The disadvantages of CBCT include lower contrast resolution (i.e. soft tissue visualization) and a longer imaging time (susceptibility to movement artifacts). CBCT has also a limited field of view, allowing only small joints and bones to be examined.

Clinical musculoskeletal applications: Because of its high spatial resolution, CBCT is a useful imaging modality for visualization of small osseous structures. In our series, CBCT adds valuable information in the diagnosis of acute and chronic (repetitive) trauma, inflammatory disease (e.g. gout, hydroxyapatite deposition, ...), grading of osteoarthritis of small joints, detection and characterization of bone tumors in small bones, as well as the postoperative evaluation of osteosynthesis.

Conclusions: CBCT provides high resolution images at a relative low radiation dose compared to conventional MDCT, and is therefore a useful modality to evaluate small bone and joint - pathology. Particularly, in the setting of acute trauma, CBCT may be useful to detect subtle or nondisplaced fractures, not visible on plain radiography. This may have important medico-legal implications, as it may have an impact on patient reassurance and management.

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CHEST

Dose is not only dose: understanding the consequences of decreasing radiation parameters

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The learning objectives of this presentation were to review the effects of lowering kVp and mA in MDCT acquisition on the x-rays attenuation of various materials and on patient dose, to understand the consequences of reducing radiation parameters on global image quality and worldwide-used abacus, i.e. the Agatston Calcium scoring method and to show alternative techniques of dose reduction in MDCT. To achieve this goal, we used an anthropomorphic cardio phantom (QRM, Germany), human cadavers and clinical data to demonstrate the effects of lowering the kVp or mAs, and iterative reconstructions on the measured CT Hounsfield unit (HU) numbers.

As previously described, HU measurements of a structure are linked to the tube voltage (kVp), depending of atomic number (Z) of the structure. HU measurements are not linked to the tube current (mAs), but mAs will influence the noise value and the standard deviation (SD) of HU measurements. Consequently, CT examination with different kVp acquisitions should not be compared (e.g. bone metastasis comparison with different kVp protocols should not be misinterpreted as an evolving osteoblastic process) and a careful attention should be paid with universal protocol-independent density threshold (e.g. for urinary stone identification).

For the same low-dose and in highly attenuating organs, the best image quality is obtained with the highest kVp acquisition, resulting in less noise, less photon starvation artifacts and less metallic artifacts (Fig. 1). Consequently, low-dose protocols should give priority to high kVp with ultra-low mAs (as far as possible) rather than low kVp. In practice, if the lowest tube current (mAs) that the CT scan can support is reached (i.e. 10 mAs on Brillance 256-Slice iCT), and if the dose can still be decreased with acceptable image quality (e.g. for pediatric examinations, thin patient or chest studies...), then tube voltage (kVp) can be decreased *secondary*. At present, limited ultra low mAs are available on modern MDCT units and the priority is given to perform low-kVp acquisition in order to reduce the radiation dose to the patient. In this way, CT manufacturers should be encouraged to develop ultra-low mAs (< 10 mAs) acquisition protocols.

An interesting characteristic of low-kVp acquisition is to enhance iodine contrast compared with adjacent tissue ($m = \Delta$ 80 kV(HU) / Δ 140 kV (HU) $\rightarrow$ iodine: $m = 1.9$ > organic tissues: $m \approx 1$) (Fig. 2).

Modifying radiation parameters (kVp, mAs) may have consequences on automatic quantification software or world-wide-used abacus. For example, radiologists have to know that Agatston coronary calcium scoring (CCS) can only be performed with 120 kVp acquisition: whether it is correlated to CT density measurements, the Agatston CCS is a non linear function of the X-rays attenuation due to a multi-threshold measurement (with a step weighting function). Consequently the variation of the HU measured when lowering the kVp used during the CT acquisition could highly increase the CCS of a low density calcification, and *in a practical way* it cannot be corrected by the adaptation of Agatston thresholds as suggested by some authors. However, low-dose Agatston CCS can be obtained reducing tube current (mAs) with iterative reconstruction to reduce the noise.

Indeed, noise level is an important parameter to obtain accurate automatic quantification.

In this way, iterative reconstructions (IR) allow noise (SD) reduction and image quality improvement, without affecting HU measurement.

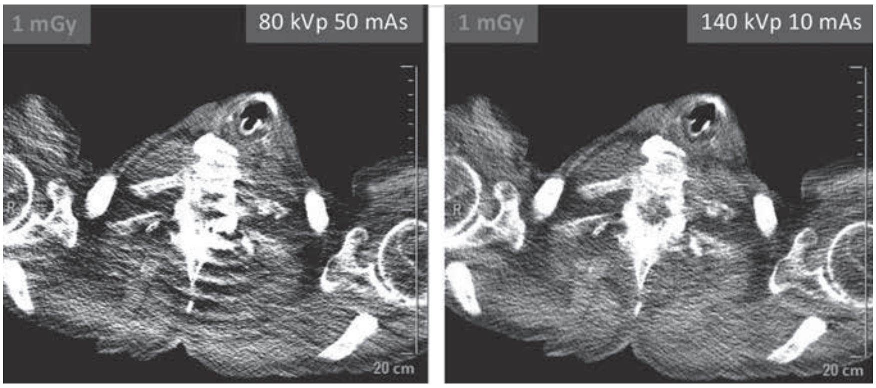

Fig. 1

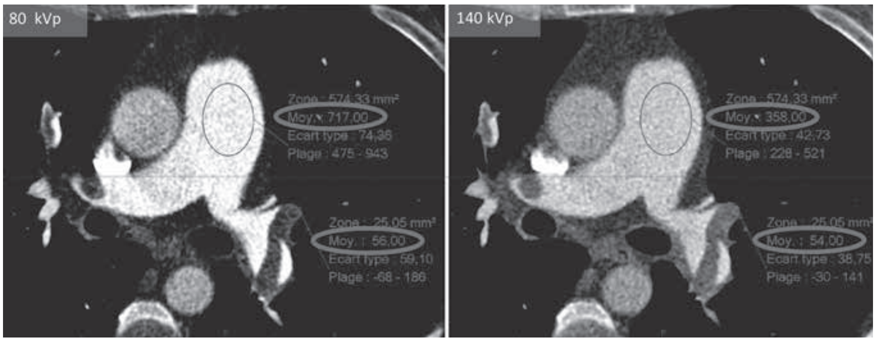

Fig. 2

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PEDIATRIC RADIOLOGY

Imaging in apophysitis and apophysiolysis

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Purpose: We reviewed the literature concerning the physiopathology and role of imaging in apophyseal lesions. We present imaging cases with emphasis on ultrasound and MRI features of apophysitis of the lower limb.

Results: Different sites of apophyses share the same physiopathology.

During apophyseal maturation, the strong fibrous cartilage converts to a weaker columnar cartilage, responsible for apophyseal ossification. This makes the apophysis more prone to injury during maturation, especially in growth spurt.

Apophysiolysis is an acute avulsion fracture of the apophysis due to a strong muscular contraction. Radiographic features are usually straight forward when ossification of the apophysis has already started. Apophysitis is an overuse injury or chronic inflammation of the apophysis and attached tendon, resulting from repetitive muscle contractions.

Radiography in apophysitis is not specific and nonconclusive. The apophysis may appear normal, irregular, may show fragmentation, osteoporotic patches or sclerosis, with bony fragments in or near the attached tendon. However this can also be seen in asymptomatic children during normal apophyseal growth.

Due to apophyseal enlargement, the ossified central part of an inflammed apophysis can mimick an avulsion fracture on radiographs.

Ultrasound in apophysitis shows typical apophyseal cartilage swelling with hypervascularisation, tendon thickening or heterogeneity and ossification in or near the attached tendon.

MRI in apophysitis shows morphologic and signal characteristics that allow precise and straightforward diagnosis. T1 sequences depict anatomical detail of the tendon and osseous fragments, apophysis enlargement at site of tendon insertion. Fluid sensitive sequences depict increased signal in the apophysis, periapophyseal bony and soft tissues. The apophysis and periapophyseal tissues enhance after IV contrast. Only discrete or absent physeal plate separation is seen in apophysitis.

Most affected sites in the lower limb are the Achilles tendon on the calcaneum (Sever), distal patellar tendon on tibial tubercle (Osgood-Schlatter), proximal patellar tendon on inferior patellar pole (Sinding-Larsen-Johansson). In the pelvis overuse injuries of the the tendons at the iliac crest, anterior iliac spines, pubic ramus, ischial tubercle and trochanters give rise to apophyseal lesions. Less known is the apophysitis of the base of the 5th metatarsal or Iselin disease.

Conclusion: Imaging in apophysitis, which is a chronic inflammation, is more complex than in apophysioloysis, which is an acute avulsion fracture. Imaging has an important role in atypical clinical findings or abscence of recovery to guide proper management.

In apophysitis radiographic imaging is nonspecific. Ultrasound and MRI are the best modalities to show apophyseal enlargement and inflammation of periapophyseal bony and soft tissues. Ultrasound provides a more easy acces to evaluate the apophyses of the lower limb, even in the pelvis. It is important to become familiar with the normal and abnormal imaging features of apophyses in the growing child to recognize their pathology.

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