Conclusions: McGonagle et al. advocated the concept of synovio-entheseal complex and suggested that the inflammation occurs primarily at the enthesis and spreads to adjacent synovial tissues such as bursae in SpA patients. Our cross-sectional data indirectly indicated that RCB precedes or accompanies AT enthesitis in a narrow definition in the early phase of the RA, suggesting that the inflammation around the enthesis of RA patients occurs primarily at the synovial tissues and spreads to the enthesis in an opposite way. In addition, the isolated AT enthesitis without RCB in the established and/or treated RA patients may suggest several possibilities as follow: 1. Enthesitis is more refractory to RA treatment than bursitis; 2. Enthesitis is partially due to the degenerative changes related to damages and deformities caused by RA synovitis; 3. US-detected enthesitis in RA basically represents repair process rather than ongoing inflammation.

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FRI0595 THE BEACH TOOL: A QUANTITATIVE MRI-BASED METHOD FOR MEASURING OEDEMA AND FAT METAPLASIA IN SPONDYLOARTHRITIS

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Background: Magnetic resonance imaging (MRI) is an important part of diagnostic pathways in spondyloarthritis (SpA), and can be used to stratify patients and assess severity. However, measurements of the burden of inflammation currently rely on qualitative assessment, which is subjective and time-consuming thus impractical for clinical practice. There is a need for a more objective, faster method for measuring inflammation and damage with potential for automation, and quantitative MRI is a candidate tool.

Objectives: We aimed to provide proof-of-principle for the BEACH (Bone Oedema and Adiposity quantification with Apparent diffusion coefficient and Chemical shift imaging with histograms) tool, which quantifies bone marrow oedema and fat metaplasia – features of active and chronic inflammation – in the SIJs.

Methods: Fifty-three patients aged 12–24 years with either SpA or mechanical back pain were recruited prospectively, and underwent quantitative MRI consisting of diffusion weighted imaging (DWI) and fat fraction (FF) mapping,^{2,3} and conventional MRI scans. Apparent diffusion coefficient (ADC) and FF maps were assessed using the BEACH tool, which automatically propagates ROIs on sub-chondral bone after the observer defines the SIJ. Pixel values were analysed to derive the histographic parameters for ADC and FF: median, 10th, 25th, 75th and 90th percentiles (denoted ADC₁₀, ADC₂₅, FF₁₀, FF₂₅, etc), and P_{high} and plough (the proportion of high and low value pixels respectively).

Conventional MRI scans were assessed using visual scoring.⁴ Patients were deemed to have active inflammation if their inflammation score was ≥2, and to have fat metaplasia if this score was ≥3. Quantitative measurements were compared between inflamed and non-inflamed SIJs.

Results: Use of the BEACH tool is demonstrated in figure 1(a)-(f). Example ADC histograms are shown in (g),(h).

ADC₇₅, ADC₉₀, and P_{high}(ADC) were significantly increased in inflamed SIJs ($P=0.041$, 0.006 and 0.003 respectively), although median ADC values did not differ significantly between inflamed and uninflamed joints ($P=0.31$). Diagnostic performance was superior for histographic parameters (AUC=0.59, 0.67 and 0.69) than for the median (AUC=0.54): Median FF, FF₇₅, FF₉₀ and P_{high}(FF) were all significantly increased in SIJs with fat metaplasia compared to those without (all $p<0.0001$). Diagnostic performance was superior for histographic parameters FF₇₅, FF₉₀ and P_{high}(FF) (AUC=0.89, 0.92 and 0.92) than for the median (AUC=0.87).

Conclusions: ADC and FF measurements can differentiate between inflamed and non-inflamed SIJs, and between joints with and without fat metaplasia. Compared to simple averages such as the median, histographic parameters can increase diagnostic performance for detecting inflammation and fat metaplasia. There is minimal subjectivity associated with ROI placement using the BEACH tool, which can potentially make inflammation scores more reproducible.

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FRI0596 FEASIBILITY OF JOINT STRUCTURAL ANALYSIS IN HEMOCHROMATOSIS HAND ARTHROPATHY USING HIGH-RESOLUTION PERIPHERAL QUANTITATIVE COMPUTED TOMOGRAPHY – FIRST RESULTS AND CLINICAL CORRELATIONS

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Background: Hereditary Hemochromatosis (HH) is a common inherited disorder and characterised by an excess iron accumulation in several organs with consecutive organ dysfunction.¹ Apart from the liver, the joints are a major site of excess iron deposition. Joint pain counts among the most frequent (>50%), earliest, and most debilitating symptoms of HH.² To date, joint health status in HH patients is routinely assessed on hand radiographs.³ However, plain radiography is a low-resolution, 2D-technique with limited sensitivity to detect early joint changes or to monitor subtle progression of joint damage.⁴ With the advent of high-resolution peripheral quantitative computed tomography (HR-pQCT), a promising imaging tool has emerged allowing for *in vivo* 3D characterisation of human joint microstructure at a spatial resolution of 130 µm.⁵ Due to its high sensitivity to detect and monitor subtle, short-term joint changes, HR-pQCT has been successfully applied to patients with RA.⁶ However, to date, HR-pQCT has not been used to characterise joint and bone changes seen in HH arthropathy.

Objectives: Here, we aimed to investigate in a cohort of HH patients 1) if the usage of HR-pQCT is feasible on HH patients; 2) to quantify joint microstructure of metacarpophalangeal joints (MCP2–4) in this specific patient group; and 3) investigate the relationship between HR-pQCT-derived joint microstructural parameters and clinical outcomes.

Methods: 25 HH patients were enrolled and their HH history and treatment were recorded. MCP joints of all patients were imaged at a clinical HR-pQCT system (XtremeCT, Scanco Medical AG). 330 images were acquired covering MCP 2, 3 and 4. The joint space (JS) morphology of each MCP was quantified from the HR-pQCT images semi-automatically⁴ and volume (JSV), joint space width mean (JSW), JSW variance (JSW.SD), and JSW asymmetry (JSW.AS) were calculated.

Results: Out of the 75 MCP joints available for analysis, 79% were successfully segmentable, and 19% required semi-manual intervention to separate the individual bones. 3 joints were excluded due to motion artefacts, and 1 joint was unsegmentable. HH patients were 32–72 years old, in 64% male, and had been diagnosed with HH 2 months to 40 years ago. 15% were pain free at the study

date. HH patients with pain showed significantly lower JSV at MCP 2 and 4 ($p=0.009$) and exhibited a significantly higher joint asymmetry in MCP 3 ($p=0.012$) compared to their pain free colleagues. When looking at clinical correlations we found that time since HH diagnosis was positively correlated with the MCP4 JSW asymmetry ($R^2=0.451$, $p=0.040$) and MCP 4 JSW.SD ($R^2=0.475$, $p=0.030$). The number of phlebotomies since diagnosis was strongly correlated with the JSW.SD (MCP2-4: $0.4552<0.581$, $p<0.050$) at all MCP sites.

Abstract FRI0596 – Figure 1. 3D surface reconstructions of the MCP3 with the local joint space width mapped into the joint space in pseudo-colour. Blue and green colours reflect narrow joint space width, while red colours code for a broader joint space width. A) 55 year old male with a BMI of 21.9 kg/m² who has been diagnosed with hemochromatosis 8 years ago, but received only occasionally phlebotomies. B) 48 year old male (BMI 22.9 kg/m²) with a diagnosis of hemochromatosis of 8 years who received regular phlebotomies every 2 months. Both patients presented at the study date with hand pain. Note the larger and more symmetrical joint space width in patient B.

Conclusions: Our study provides the first evidence that joint space assessment of MCPs via HR-pQCT in patients with hereditary hemochromatosis is feasible and can provide a thorough structural joint characterisation and thus support the physician in his initial HH arthropathy assessment. Our findings suggest, that regular phlebotomies since diagnosis may preserve joint space morphology leading to a more evenly maintained joint space. However, larger studies are needed to validate our results.

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FRI0597 VALIDATION OF WEB-BASED CALIBRATION MODULES FOR IMAGING SCORING SYSTEMS BASED ON PRINCIPLES OF ARTIFICIAL INTELLIGENCE: THE SPARCC MRI SACROILIAC JOINT INFLAMMATION SCORE

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Background: The application and appropriate use of imaging-based scoring instruments is usually based on passive learning from published manuscripts while real-time interaction with instrument developers is often non-feasible. Moreover, most instruments lack knowledge transfer tools that would facilitate attainment of pre-specified performance targets for reader reliability.

Objectives: 1. To develop a web-based calibration module for the SPARCC MRI SIJ Inflammation Score based on consensus scores from these instrument developers, experiential game psychology, and real-time iterative feedback. 2. To test

the feasibility and attainment of pre-specified performance targets for reader reliability.

Methods: The scoring of inflammatory lesions of the SIJ on MRI using the SPARCC method is based on SIJ quadrants and the calibration module is comprised of 50 DICOM cases, each with scans from baseline and 12 weeks after the start of TNF inhibitor therapy. Scans are scored blinded-to-time-point. Continuous visual real-time feedback regarding concordance/discordance of scoring per SIJ quadrant with expert readers is provided by a color-coding scheme. Reliability is additionally assessed by real-time intra-class correlation coefficient with the first ICC data being provided after 20 cases. Accreditation for SPARCC BME score is achieved with status and change score ICC of >0.8 and >0.7 and is based on the final 20 cases. 26 readers scored the SPARCC BME module (7 rheumatology fellows, 2 chiropractors, 1 undergraduate, 8 rheumatologists, 8 radiologists) with 21 having no prior experience. Feasibility was assessed by 8-item survey.

Results: The majority of readers achieved accreditation for SPARCC BME score on the basis of sufficient reliability with instrument developers for both status and change scores, irrespective of prior experience (table 1). All readers who completed the module a second time, 6 months after the first exposure, achieved accreditation for SPARCC BME score. All readers rated the modules as easy and intuitive with average time for reading each case for SPARCC BME being 8 min.

Abstract FRI0597 – Table 1

	Status Score			Change Score		
	Mean ICC (95%CI)	Median ICC	N (%) Achieving ICC $>0.80^*$	Mean ICC (95% CI)	Median ICC	N (%) Achieving ICC $>0.70^*$
All readers (N=26)	0.84(0.81-0.87)	0.84	18(69.2%)	0.74(0.69-0.79)	0.76	17(65.4%)
Second read (N=8)	0.89(0.87-0.91)	0.89	8 (100%)	0.84(0.79-0.90)	0.86	8 (100%)
Naïve readers** (N=10)	0.83(0.79-0.87)	0.84	8 (80%)	0.74(0.66-0.83)	0.79	7 (70%)
Rheumatologists (N=8)	0.86(0.79-0.92)	0.85	6 (75%)	0.78(0.69-0.87)	0.79	6 (75%)
Radiologists (N=8)	0.84(0.77-0.91)	0.82	4 (50%)	0.70(0.59-0.81)	0.72	4 (50%)

*Proficiency targets for reader reliability

**7 rheumatology fellows, 2 chiropractors, 1 undergraduate

Conclusions: Experiential web-based learning is an effective and feasible calibration tool to achieve proficiency targets in the scoring of MRI scans for SIJ inflammatory lesions.

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FRI0598 THE AGREEMENT BETWEEN CLINICAL SIGNS AND ULTRASOUND-DETERMINED JOINT INFLAMMATION IN PATIENTS WITH RHEUMATOID ARTHRITIS

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Background: The identification of synovial inflammation in rheumatoid arthritis (RA) patients mainly depends on the presence of tenderness and/or swelling joints by physical examination, however not entirely reliable. Ultrasound, especially the synovial hyperplasia evaluated by grey scale (GS) and synovitis by power Doppler (PD), is more sensitive in reflecting joint inflammation, but their clinical significance has not been fully understood^[1].

Objectives: To investigate the agreement between clinical-detected signs and US features of joint inflammation in wrists and hands, and further determine the grades of GS synovial hyperplasia and PD synovitis which correspond to presence of tenderness or swelling in an individual joint in RA patients.

Methods: Twenty-two joints, including bilateral wrists, proximal interphalangeal (PIP) and metacarpophalangeal (MCP) joints, were respectively evaluated by clinical and ultrasound examination by different rheumatologists in 258 RA patients. Ultrasound-determined joint inflammation, including synovitis, tenosynovitis/peritendinitis, were detected, by using semi-quantitative scoring systems (0–3) for GS