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OP0292
CLASSIFICATION OF PSORIATIC ARTHRITIS, SERONEGATIVE RHEUMATOID ARTHRITIS, AND SEROPOSITIVE RHEUMATOID ARTHRITIS USING DEEP LEARNING ON MAGNETIC RESONANCE IMAGING

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Background: While MRI evaluation of joints has been primarily used to quantify inflammation at a cross-sectional and longitudinal level, less is known about the potential of MRI in distinguishing different patterns of inflammation in the various forms of arthritis.

Objectives: To evaluate (i) whether deep learning using neural networks can be trained to distinguish between seropositive rheumatoid arthritis (RA+), seronegative RA (RA-), and psoriatic arthritis (PsA) based on structural inflammatory patterns on hand magnetic resonance imaging and (ii) to assess if psoriasis patients with subclinical inflammation fit into such patterns.

Methods: ResNet 3D [1] neural networks were trained to distinguish (i) RA+ vs. PsA, (ii) RA- vs. PsA and (iii) RA+ vs. RA- with respect to hand MRI data. Diagnosis of patients was determined using the following guidelines: ACR/EULAR 2010 [2] for RA and CASPAR [3] for PsA. Results from T1 coronal, T2 coronal, T1 coronal and axial fat suppressed constraint-enhanced (CE) and T2 fat suppressed axial images were used. The performance of such trained networks was relevant for classification, however, when deleting CE sequences, the loss of performance was only marginal. The addition of patient-specific data to the networks did not provide significant improvements. Increasing amounts of training data demonstrated improved performance of the networks (Figure 1B). Psoriasis patients were mostly assigned to PsA by the neural networks, suggesting that PsA-like MRI pattern may be present early in the course of psoriatic disease.

Table 1. Overview of demographic and clinical information.

<table>
<thead>
<tr>
<th></th>
<th>RA+</th>
<th>RA-</th>
<th>PsA</th>
<th>Psoriasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number (N)</td>
<td>649</td>
<td>629</td>
<td>80</td>
<td>72</td>
</tr>
<tr>
<td>Number (N)</td>
<td>190</td>
<td>135</td>
<td>177</td>
<td>147</td>
</tr>
<tr>
<td>Age (years), mean±SD</td>
<td>56.9±12.6</td>
<td>60.5±10.3</td>
<td>56.3±12.0</td>
<td>49.6±13.8</td>
</tr>
<tr>
<td>Sex (female/male)</td>
<td>126/64</td>
<td>93/42</td>
<td>92/85</td>
<td>71/76</td>
</tr>
<tr>
<td>BMI (kg/m²), mean±SD</td>
<td>26.6±10.5</td>
<td>27.6±8.3</td>
<td>29.1±11.3</td>
<td>26.7±6.9</td>
</tr>
<tr>
<td>Disease duration (years), mean±SD</td>
<td>2.6±4.9</td>
<td>1.3±2.3</td>
<td>0.8±2.3</td>
<td>4.2±5.1</td>
</tr>
<tr>
<td>tasDAS28, mean±SD</td>
<td>3.3±1.3</td>
<td>3.4±1.2</td>
<td>3.2±1.3</td>
<td>3.2±1.3</td>
</tr>
<tr>
<td>CRP (mg/L), mean±SD</td>
<td>0.9±2.5</td>
<td>0.7±1.2</td>
<td>0.5±0.8</td>
<td>0.5±1.3</td>
</tr>
<tr>
<td>HAQ, mean±SD</td>
<td>0.8±0.6</td>
<td>0.9±0.8</td>
<td>0.6±0.6</td>
<td>0.3±0.4</td>
</tr>
<tr>
<td>Medication</td>
<td>bDMARD</td>
<td>bDMARD</td>
<td>bDMARD</td>
<td>bDMARD</td>
</tr>
<tr>
<td>oDMARD, mean±SD</td>
<td>89.52%</td>
<td>88.89%</td>
<td>80.54%</td>
<td>12.28%</td>
</tr>
</tbody>
</table>

Conclusion: Deep learning can be successfully applied to differentiate MRI inflammatory patterns related to RA+, RA-, and PsA. Early changes in psoriasis patients can be recognized by neural networks and are characterized by a pattern that allowed the networks to classify them as PsA.

REFERENCES:

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Figure 1. (A) Neural network combining MR sequences with optional additional clinical data. The prediction for a single case is formed by averaging the prediction of all sequences and the prediction of all and axial fat suppressed contrast-enhanced (CE) and T2 fat suppressed axial images were used. The performance of such trained networks was relevant for classification, however, when deleting CE sequences, the loss of performance was only marginal. The addition of patient-specific data to the networks did not provide significant improvements. Increasing amounts of training data demonstrated improved performance of the networks (Figure 1B). Psoriasis patients were mostly assigned to PsA by the neural networks, suggesting that PsA-like MRI pattern may be present early in the course of psoriatic disease.

OP0293
PHOTOREALISTIC DEPICTION OF RHEUMATIC PATHOLOGIES BY CINEMATIC RENDERING FACILITATES DISEASE UNDERSTANDING OF PATIENTS WITH RHEUMATIC DISEASES

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None declared

Disclosure of Interests: None declared

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Background: Treatment success of a rheumatic disease crucially depends on whether a patient is sufficiently informed about the disease[1]. Visual methods are suitable for explaining diseases[2]. Cinematic rendering (CR) is a new method that allows to segment standard medical images into images that illustrate disease pathologies in a photorealistic way. As such, CR provides new opportunities to visualize diseases and but could therefore be a valuable tool for patients with rheumatic and musculoskeletal disease (RMD).[3]

Objectives: We questioned, if it is possible to apply CR on images from structural lesions of patients with rheumatoid arthritis (RA), Psoriatic Arthritis (PsA) and axial Spondyloarthritis (axSpA) and to test whether such images are helpful to patients with RMDs to understand their disease process. Application in doctor-patient communication.

Methods: We selected conventional computed tomography (CT) and high-resolution peripheral CT (HR-pQCT) from patients with rheumatoid arthritis (RA), Psoriatic Arthritis (PsA) and axial Spondyloarthritis (axSpA) that showed typical changes of the respective disease. HR-pQCT measurements were performed in RA and PsA at the Rheumatology Department. CT Measurements of the spine in an axSpA patient was provided from AH. All images were segmented to CR images using a prototype software by the manufacturer Siemens Healthineers. In a prospective study on consecutive patients with RA, PsA, axSpA these images were used to explain the depicted pathognomonic pathologies and compared to conventional imaging in a structured doctor-patient interview. In the last step, patients filled in a quantitative questionnaire (Likert Scale 1-5) about their perspectives answering following questions: Did you understand your disease in the provided Cinematic Rendering images? Did you understand your disease better through the presentation using Cinematic Rendering images than with a normal X-ray image? Do you think it would be reasonable to use this type of Cinematic Rendering to improve patients’ understanding of their disease? Descriptive statistical methods were used.

Results: CR images of rheumatic diseases were successfully generated from above mentioned imaging data (CT, HR-pQCT). Bone erosions, osteophytes, entheseopathies, osteoporosis and ankylosis of the spine could be visualized in photorealistic detail. Figure 1 shows examples of a images of a patient with RA and axSpA with typical bone changes. 65 patients (23 RA/23 PsA/19 axSpA; f 55%) were guided through CR images of their respective disease by an experienced rheumatologist, followed by complet- ing the questionnaire mentioned above. Patients stated that CR was very helpful to understand their disease process (4.39±0.15), that understanding diseases with CR was better than the one obtained by conventional radiographs (4.43±0.20) and that they considered such technology helpful for improving disease understanding (4.35±0.09).

Conclusion: CR seems to be a promising teaching tool for RMD patients facilitating an improved understanding of their disease process and in conse- quence my also improve adherence of RMD patients to their anti-rheumatic treatment.

REFERENCES:

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OP0294 REDUCED JOINT SYNOVITIS ASSESSMENT VERSUS THE GLOBAL EULAR OMERACT SYNOVITIS SCORE (GLOESS) TO PREDICT THE RESPONSE TO SECUKINUMAB IN PATIENTS WITH ACTIVE PSORIATIC ARTHRITIS AND INADEQUATE RESPONSE TO CONVENTIONAL DISEASE-MODIFYING ANTI-RHEUMATIC DRUGS: EXPLORATORY RESULTS FROM THE ULTIMATE TRIAL

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Background: The combined use of B-mode ultrasound (US) and Power Doppler (PD; combination termed as PDUS) allows visualisation of morphological and pathophysiological changes of the synovium. ULTIMATE (NCT02662985) was the first large, randomised, double-blind, placebo-controlled PDUS phase IIb study in psoriatic arthritis (PsA), to demonstrate that Global OMERACT EULAR Synovitis Score (GLOESS), a US score at patient level, was sensitive to detect the early and continuous decrease in synovitis in a multicenter setting using different US devices and examiners. However, the US assessment for GLOESS was time-consuming owing to the number of joints assessed.

Objectives: To investigate the value of various reduced joint sets to predict the validated GLOESS score.

Methods: ULTIMATE was a 52-week study with a 12-week double-blind, placebo-controlled period followed by 12-week open-label (OL) treatment and 6-month OL extension period. In the ULTIMATE trial, GLOESS for the 24 paired joints was calculated, with a potential score ranging between 0 to 144. A Spearman’s rank correlation matrix and a Cluster Image Map were constructed to identify highly correlated joint clusters based on the composite PDUS scores. Based on the different approaches (best correlation, model optimization, etc.), representative joints were then selected from each group, which yielded several corresponding combinations of joints. Linear models were developed with these reduced joint sets as predictors of GLOESS, using data from 60% of patients randomly selected from the