MR-Fluoroscopy-Guided Steroid-Infiltration of the Sacroiliac Joint in Therapy Refractory Sacroiliitis: Efficacy and Specific Properties

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Purpose:

To evaluate the efficacy of MR imaging-guided steroid infiltration of the sacroiliac joints on inflammatory back pain and the subchondral bone marrow edema in patients with therapy refractory sacroiliitis due to seronegative spondylarthropathy and to evaluate the specific properties of MR-Fluoroscopy guidance in comparison with discontinuous MR imaging guidance using step-by-step imaging technique at an open low-field MR-Scanner.

Materials and Methods:

Patients were consecutively enrolled in this study. Inclusion criteria were a seronegative spondylarthropathy with therapy refractory MR imaging verified acute sacroiliitis and inflammatory back pain ≥ 6 months. At the day of the MR intervention and three month following the MR intervention inflammatory back pain and sacroiliitis were documented. Inflammatory back pain was assessed on a 10-point visual analog scale (VAS). Sacroiliitis was documented by high-field MR imaging according to a standard protocol. The activity of the subchondral bone marrow edema was evaluated by computerized signal intensity measurements on the MRI workstation (Syngo Software, Siemens, Erlangen, Germany). Responder criteria were defined as an absolute reduction of the VAS score ≤ 5, a relative reduction of the VAS score ≥ 35 % and persisting improvement ≥ 2 months. For intervention a clinical C-shaped open 0.2-T-MR-Scanner (Magnetom Open, Siemens) with dedicated interventional accessories was used. The entire intervention was performed with patients in prone position. The subchondral bone marrow edema was localized by an axial inversion recovery sequence. For anatomic orientation and planning of the virtual needle pathway an axial T1W spin echo sequence was used. For MR-Fluoroscopy guidance a self-repeating SSFP sequence (FISP, TR/TE/Matrix/TA = 17.8/8.1/68x128px/1s) was used. Puncture site evaluation and needle placement was performed with free-hand technique and continuous action control on an in-room monitor (Fig. 1). Step-by-step MR imaging guidance was performed using single gradient echo MR images (FLASH 2D, TR/TE/Matrix/TA = 54ms/7,4ms/96x256px/28s). Before needle placement, the puncture site was prepped and draped in a sterile fashion. Lidocain was instilled subcutaneously at the determined skin entry points. Following needle placement two perpendicular gradient echo MR sequences ensured accurate articular position of the needle tip (Figure set 2). For puncture and delivery of 1 ml triamcinolonacetonid (Volon A 40, Bristol-Myers Squibb, New York, USA) per joint a MR-compatible therapy needle (MR-Needle Edition 2000, Somatex, Teltow, Germany) was used. Finally the initial inversion recovery sequence was repeated. After the intervention patients were observed for two hours in prone position. Written informed consent for use of medical records in research purposes and scientific publication were obtained from all patients. Variables were compared using McNemar-Test and Wilcoxon-Test. The mean remission time was calculated using a Kaplan-Meier analysis. p-values < 0.05 were considered statistically significant.

Results:

40 patients (31 years (17-65 years), 14 women) underwent MR imaging-guided steroid infiltration of the sacroiliac joints. In 20 patients the infiltration (6 unilateral, 14 bilateral) was performed by near real-time guidance using MR-Fluoroscopy and in 20 patients infiltration (9 unilateral, 11 bilateral) infiltration was performed using discontinuous step-by-step MR imaging guidance. The intervention was technically successfully performed in all patients using MR imaging guidance only. The procedure was well tolerated by all patients. No complications and specially no infections occurred. Following MR imaging-guided steroid infiltration of the sacroiliac joints there was a statistically significant ($p < 0.001$) improvement of the VAS score from 8 (5-10) points to 3 (0-8) points (- 62.5%) in all patients (n=40). Of 40 patients 33 (82.5%) fulfilled the predefined responder criteria. In this group there was a statistically significant ($p < 0.01$) improvement of the VAS score from 8 (5-10) to 2 (0-5) (- 75%). In the non-responder group there were no significant changes. There was a significant ($p < 0.01$) reduction of the signal intensity of subchondral bone marrow of 65% in all patients (n=40). In the responder group there was a significant ($p < 0.01$) reduction of 63 %. In the non-responder group a significant ($p < 0.01$) reduction of 57 % was observed although there was no significant reduction of inflammatory back pain. The mean remission time was 11 (4-22) months. MR-Fluoroscopy was feasible in all patients. The FISP sequence was characterized by lower resolution and lower tissue contrast compared to FLASH 2D sequence but did provide fast imaging of sufficient quality for MR imaging-guided infiltration of the sacroiliac joint (Fig. 1). Time course analysis revealed a marked learning curve in performing MR imaging-guided infiltration of the sacroiliac joints in both techniques. The average procedure time for puncture site evaluation (1.5 min (0.5 min-3.5 min) and needle placement (4 min (1.5 - 9.5 min) was significant ($p < 0.01$) lower with MR-Fluoroscopy guidance compared to step-by-step MR imaging guidance (puncture site evaluation: 5 min (3 min - 9 min); needle placement: 9 min (5.5 min - 16 min)). This resulted in a significant ($p < 0.01$) lower average total procedure time using MR-Fluoroscopic technique (unilateral: 35 min (29 min - 52 min), bilateral: 39 min (34 min - 68)) compared to step-by-step MR imaging technique (unilateral: 43 min (38 min - 63 min), bilateral: 52 min (40 min - 72 min)).

Conclusion:

MR imaging-guided steroid infiltration of the sacroiliac joints proved to be an effective treatment of inflammatory back pain in therapy refractory sacroiliitis with long lasting results. A reduction of the subchondral bone marrow edema was observed in responders and non-responders. MR-Fluoroscopy proved to be a feasible and time saving modality. It provided sufficient MR imaging for near real-time guidance and accurate and safe device placement.

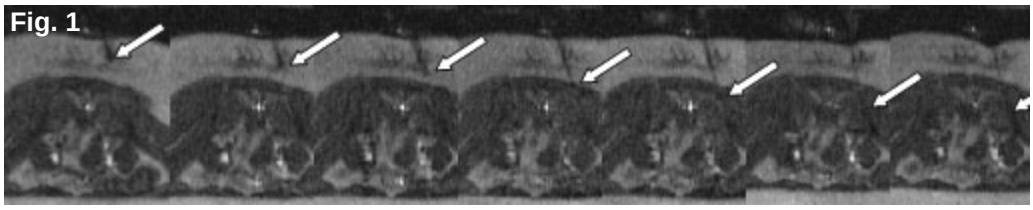

Fig. 1: MR-Fluoroscopy (FISP sequence) image sequence demonstrating near real-time action control during needle placement. White arrows indicate the moving needle tip.

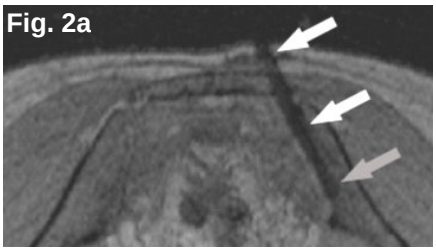

Figure set 2: Two perpendicular orientated gradient echo sequences (FLASH2D) for confirmation of the correct articular position of the therapy needle.
Fig. 2a (left image): Axial MR image showing the needle (white arrows) and the needle tip (white arrow). Fig. 2b (right image): Sagittal angulated MR image confirming the position of the needle tip (white arrow).