

SP56: Should and how frequently MRI be performed in assessing disease healing pyogenic spondylodiscitis?

Pushpa. B.T., Andreas K. Demetriades, Koji Yamada, Maximilian Reinhold, Eiichiro Iwata

Response/Recommendations: From the available data, it is difficult to make any strong recommendation regarding the ideal duration for follow-up study or frequency of surveillance MRI in pyogenic spondylodiscitis. There may also be a chance that routine MRI follow-up may not be mandatory when there is adequate clinical improvement, but this would be based on very low-quality observational studies.

Level of Evidence: Consensus

Delegate Vote:

Rationale:

A systematic review was conducted to evaluate the utility of magnetic resonance imaging (MRI) in assessing the healing of pyogenic spondylodiscitis (PSD) and frequency at which MRI has to be performed during the treatment. Pub-med, Web of Science, Clinical trials.org and Scopus were searched from inception till January 01, 2025, for original articles reporting follow up MRI during treatment of PSD. We excluded publications in non-English language, case reports, review articles, registry-based studies, studies with only pediatric population, and studies on tubercular spondylodiscitis. Initial database screening resulted in 1564 articles, and after relevant exclusions 74 articles were subjected to title and abstract screening. We shortlisted nine articles for full-text screening. All studies were of retrospective nature and provided level IV evidence.

MRI has shown high sensitivity and specificity for the diagnosis of PSD, however, its role for routine follow up is not well established. The selected nine articles were published between 1996-2023, and include a total of about 400 patients.

The earliest study on temporal evolution and resolution of PSD on MRI was reported by Gilliam et al. This evaluated various MRI findings like bone marrow fatty changes, vertebral body destruction, inter-vertebral disc changes, soft tissue changes, and gadolinium enhancement. It concluded that early imaging was quite atypical. Soft tissue changes resolved early in the treatment course, whereas fatty replacement in the periphery of the bone lesion was a definitive feature of imaging. Bone destruction and disc changes might worsen in the majority of patients despite clinical status. Contrast enhancement persisted long after soft issue changes resolved (1). Ahn et al performed a similar analysis of follow-up MRI findings and correlated with ESR and CRP. MRI showed variable responses with early resolution of the soft tissue changes and showed a good correlation with CRP. Bone changes had a better correlation with ESR (2). Eba at al evaluated bone, disc, and soft tissue changes at the end of therapy and 6 months later; they showed that soft tissue changes reduced early in treatment course with complete resolution during later stages. Bone and disc changes were unnecessary if clinical and lab findings improved.(3) It was also shown that clinical worsening was never associated with an improved MRI, and clinical improvement was overall not predictive of MRI results and vice versa(4). A repeat bone biopsy was not

recommended if soft tissue changes resolved with persistent or worsening bone and disc changes in patients who were improving clinically.(5)

Studies have also exclusively evaluated the soft tissue changes in PSD in the early follow-up period based on grading of clinical improvement. Patients with good resolution of soft tissue changes on MRI had the highest disease-free interval, for more than a year. It was concluded that patients with worsening clinical status and inflammatory biomarkers would benefit from MRI.(6, 7) Prompt resolution of soft tissue abscesses on MRI is seen in response to antibiotic therapy. However, they are not prognostic indicators (8). Zarrouk et al showed contradictory findings when follow-up imaging was performed at three and six months. They concluded that imaging findings often persist despite clinical improvement, i.e. MRI findings take longer to resolve than the clinical picture. Furthermore, they do not correlate with relapses, neurological consequences, or residual pain (9).

Resolution of soft tissue changes and fatty replacement of the marrow are considered to be the two relevant MRI parameters of healing in pyogenic spondylodiscitis. Changes in the disc space and vertebral body destruction may worsen or remain the same during treatment posing difficulties in assessing the treatment response. Hence, we believe that follow-up MRI should be cautiously interpreted with attention to the clinical and laboratory findings.

Conclusion:

Based on our systematic review of the limited available and relevant evidence, it is difficult to make any strong recommendation regarding the frequency of MRI follow-up. There was no literature to suggest an ideal duration for follow-up imaging or the frequency at which the follow-up MRI should be performed. It is arguable that routine MRI follow-up may not be mandatory when there is adequate clinical improvement and that it could be reserved for cases with no clinical improvement, but based on very low-quality observational studies. The evidence regarding this topic is very limited, and therefore these findings should be further evaluated with higher-quality targeted studies with robust methodology. The cost-effectiveness implications of this are self-explanatory.

Table 1: Characteristics of studies included in the analysis.

References:

1. Gillams AR, Chaddha B, Carter AP. MR appearances of the temporal evolution and resolution of infectious spondylitis. *Am J Roentgenol*. 1996 Apr;166(4):903–7.
2. Ahn KS, Kang CH, Hong SJ, Kim BH, Shim E. The correlation between follow-up MRI findings and laboratory results in pyogenic spondylodiscitis. *BMC Musculoskelet Disord*. 2020 Dec;21(1):428.
3. Euba G, Narváez JA, Nolla JM, Murillo O, Narváez J, Gómez-Vaquero C, et al. Long-Term Clinical and Radiological Magnetic Resonance Imaging Outcome of

Abscess-Associated Spontaneous Pyogenic Vertebral Osteomyelitis Under Conservative Management. *Semin Arthritis Rheum*. 2008 Aug;38(1):28–40.

4. Malani PN, Gomez-Hassan D, Cinti SK. Association Between Follow-Up Magnetic Resonance Imaging and Clinical Status Among Patients With Spinal Infections. *Infect Dis Clin Pract*. 2012 Sep;20(5):326–9.
5. Barreto S, Sharma S, Cheraya G, Swarnkar A, Ogden K, Mangla R. Finding MRI features to obviate the need of repeat spinal biopsies in clinically suspected persistent or recurrent spinal osteomyelitis. *Pol J Radiol*. 2023 Apr 21;88:225–30.
6. Kowalski TJ, Berbari EF, Huddleston PM, Steckelberg JM, Osmon DR. Do Follow-Up Imaging Examinations Provide Useful Prognostic Information in Patients with Spine Infection? *Clin Infect Dis*. 2006 Jul 15;43(2):172–9.
7. Hecquet S, Verhoeven F, Aubry S, Prati C, Wendling D, Chirouze C, et al. Interest of Follow-Up Radiological Imaging in Patients with Pyogenic Vertebral Osteomyelitis. *J Clin Med*. 2021 Jun 18;10(12):2690.
8. Veillard E, Morcet N, Meadebl J, Bellol S, Perdrigerl A, Chalks G. RBgression rapide des abcks paravertbraux et des 6pidurites au tours de l'holution des spondylodiscites A germes banals. A propos de 16 spondylodiscites Bvalu4es en IRM.
9. Zarrouk V, Feydy A, Sallès F, Dufour V, Guigui P, Redondo A, Fantin B. Imaging does not predict the clinical outcome of bacterial vertebral osteomyelitis. *Rheumatology (Oxford)*. 2007 Feb;46(2):292-5. doi: 10.1093/rheumatology/kel228. Epub 2006 Jul 28. PMID: 16877464

Sl. No	Author	Year	Sample size	Factors compared with follow up MRI	median time of follow-up imaging	Conclusion statement
1	Baxi et al	2012	98	MRI and clinical, lab status	47.5d ays	There is clear utility of imaging if the patient worsens clinically, however MRI is unnecessary if patient improves.
2	Kowalski et al	20o6	79	MRI and clinical improvement	4-8week s	softissue changes only evaluated. patients with worsening clinical and lab findings should undergo MRI
3	Barreto	2003	17	MRI and need for repeat biopsy	not specified	Soft tissue and epidural abscess are better indicators of healing and biopsy is not need if there is improvement
4	Hecquet et al	2021	86	MRI and CT, clinical and lab data(soft tissue changes only compared)	2-4mont hs	No change in abscess and other soft tissue changes in responders and non-responders
5	Euba et al	2008	not specified	MRI and clinical , lab All parameters	not specified	No change in bone and disc, Regression in soft tissue changes. MRI not recommended if patient clinically improves
6	Gilliams et al	1996	25	MRI (all changes) and clinical and lab	2-104w eeks	Fatty changes in bone and resolution of soft tissue indicated healing. Contrast enhancement persists after clinical healing

7	Veillard et al	1999	16	MRI(all parameters)and clinical and lab	30 days, 3months and 6months	soft tissue collection improves by end of 3months
8	Ahn et al	2020	48	MRI(all parameters), ESR, CRP	42days	follow up MRI shows variable response, CRP correlates with soft tissue and ESR corelates with bone changes
9	Zarrouk et al	2006	29	MRI(all parameters) and clinical and lab	3 and 6 months	imaging findings often persists inspite of improvement clinically. They do not corelate with relapses, neurological consequences or residual pain variable. Persistent bone and disc changes did not mean treatment failure and MRI