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Correlation between Modic Changes and Facet Joint Osteoarthritis in the Lumbar Spine: A Retrospective MRI Study

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Abstract: ***Aim: The aim of this study is to assess the facet joint osteoarthritis in patients with lumbar Modic changes (MCs) and to investigate the relationship between the Modic types and severity of the facet joint degeneration in south indian population suffering from chronic back pain. Patients and Methods: Retrospective T1 and T2 MRI images of the lumbar spine of 90 patients with MCs and 30 patients without MCs were correlated with degenerative changes in the corresponding facet joints. Results: Lumbar vertebrae without MCs were not associated with degenerative changes in the corresponding facet joints. However, MCs in the vertebrae were associated with facet joint degeneration. Conclusion: Facet joint degeneration is the cause of low backache in patients with MCs in their lumbar spine. The study suggests that the therapy for the joint degeneration may be helpful in alleviating the low backache.***

Keywords: Lumbar spine, Modic changes, Osteoarthritis, Patharia grading

1. Introduction

Modic type endplate changes represent a classification for vertebral body endplate MRI signal, first described by Modic MT *et al*[1]. Modic type I changes represents bone marrow oedema and inflammation with low signal T1 and high signal T2 images. Modic type II represents normal red haemopoietic bone marrow conversion into yellow fatty marrow as a result of marrow ischemia with high signal T1 and iso to high signal T2 images. Modic type III represents subchondral bony sclerosis, low signal T1and low signal T2 images. The MCs are associated with low back pain[2]. The etiology of the MCs is not clear, however, it may be related to mechanical stress, focal bacterial infection or autoimmune reaction[3,4, 5].

Facet joints of the lumber vertebra are synovial joints of the spine. These joints are more vulnerable for degenerative changes because of the high mobility and mechanical forces in the lumber region. The degenerative changes in these joints are classified according to Patharia grading system[6] [Figure 1,2]. The normal joints are considered of Grade 1 as there are no degenerative findings. Grade 2 changes include mild joint space narrowing or mild osteophyte formation. Grade 3 joints have moderate sclerosis or moderate osteophyte formation. Joints with marked osteophyte or subchondral cyst are classified as grade 4 joints. The purpose of this retrospective study is to evaluate the relationship between MCs and osteoarthritis changes in the facet joints in cases of chronic back pain.

2. Material and Methods

MRI is the modality of choice for the assessment of MCs and facet joint degeneration because chronic degenerative osteoarthritic processes in the synovial joints involve active synovial inflammation, which can be detected using MRI with fat saturation technique. In this retrospective study Ti/T2 MRI images of the lumbar spine of 120 patients, who clinically presented with low back pain, were reviewed. The selected scans were divided into four equal groups of 30 according to Modic type such as no changes, type 1, type 2 and type 3 MCs. 60 facet joint for each Modic type, at same lumbar vertebra, were analyzed. The severity of the osteoarthritis in the lumbar facet joints were evaluated by using Pathria grading system with MRI. In addition, using MRI, compression of the thecal sac, compression of nerve roots, inflammation of the surrounding soft tissues, and the fat–filled neuroforamen were also assessed simultaneously. All images were obtained from a 1.5-T MRI system with spinal coil. The imaging protocol contained T1 weighted spin-echo sequences and axial and sagittal T2- weighted spin sequences.

Inclusion Criteria:
MRI scans of lumbar spine of male and female patients aged between 40 to 70 years, who complained of low back pain done during 2017 to 2019 were included in the study.

Exclusion Criteria:
In this study only those cases were included in whom there was no other positive MRI findings like lumber disc herniation or stenosis.

Data Collection:
Clinical history, gender, age, occupation, clinical examination notes and T1 and T2 MRI images of the patients were reviewed.

Data Analysis:
A two sample t test was used to compare continuous data. The categorical data were analyzed using chi-square test. A p value of < 0.05 was considered statistically significant.

3. Results

Lumbar vertebrae with no MCs were not associated with any degenerative changes in the corresponding facet joints. However, MCs in the lumbar spine were found to be associated with facet joint degeneration. The degree of degeneration in the joints increased with increase in the type

of the MCs. The results are in compliance with the other similar studies[7,8]. The study results are depicted in Table 1, 2 and 3.

Table 1: No. of MCs positive cases at different spinal levels

Spinal Level	No. of Type 1 MCs Total MRI reviewed =30	No. of Type 2 MCs Total MRI reviewed =30	No. of Type 3 MCs Total MRI reviewed =30
L2-L3	3	3	2
L3-L4	4	5	6
L4-L5	13	14	15
L5-S1	9	8	7

Table 2: No. and % facet joint degeneration with various MCS

Type of MCs	No. and percentage of facet joints with degenerative changes grade 1	No. and percentage of facet joints with degenerative changes grade 2	No. and percentage of facet joints with degenerative changes grade 3
No change	2 3.33%	0	0
Type 1	5 8.33%	1 1.66%	1 1.66%
Type 2	6 10%	5 8.33%	3 5.0%
Type 3	7 11.66%	8 13.33%	8 13.33%

Table 3: Percentage of grade 3 facet joint degeneration and type of MCs

No Modic changes	Type 1 Modic changes	Type 2 Modic changes	Type 3 Modic changes p < .005
0%	14.28%	21.4%	34.7%

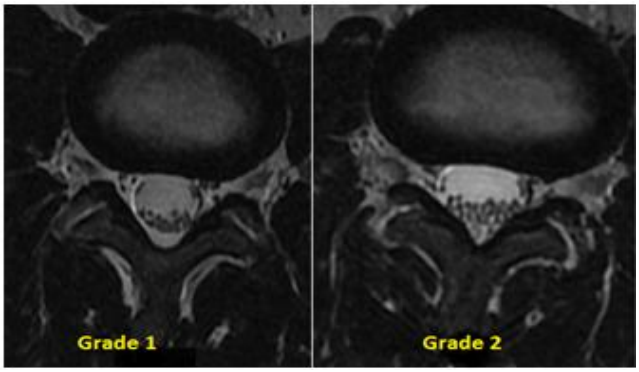

Figure 1: Grade 1,2 facet joint degeneration

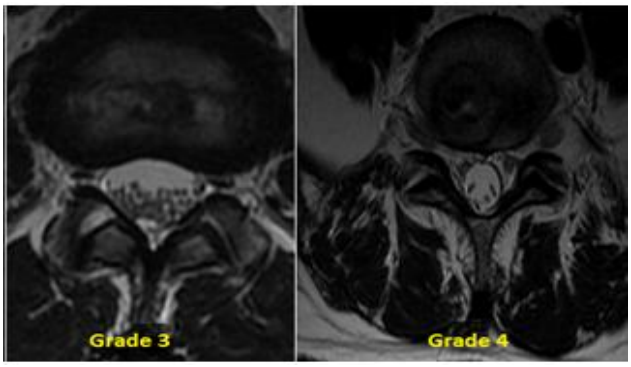

Figure 2: Grade 3,4 facet joint degeneration

4. Discussion

Modic changes (MCs) are a term used to describe the changes of the vertebral endplate which are related to spinal degeneration. Patients with MCs in the lumbar spine are different from other patients with normal back pain because such patients do not have a pain-free moment. The persistent pain is due to associated osteoarthritic changes in the facet joints. Coexisting facet joints degeneration and MCs of the lumbar spine is the main cause of chronic backache because mechanical stress is exacerbated in facets that are more horizontal in sagittal plane, typically at the L4-L5 level. This is due to the fact that MCs are significantly related to decreased angular motion and increased translational motion in the lumbar spine[9]. The objective of this study was to correlate the type of MCs in the vertebral endplate of the lumbar spine and severity of the facet joint degeneration using MRI. If such patients are diagnosed properly, imaging guided lumbar facet injection therapy may alleviate the pain. Since no physical examination tests are pathognomonic for symptomatic facet joint degeneration[10,11],T1/T2 MRI images were reviewed to see changes in the vertebral endplate [Table 4] as CT is insensitive to early changes of oedema and fatty replacement, while on X Ray, only type III sclerotic changes are visualized. Although CT is the most sensitive technique in detecting and grading degenerative facet disease, MRI may be helpful in assessment of MCs and facet joint degeneration because chronic degenerative osteoarthritic processes in the synovial joints involve active synovial inflammation, which can be detected using MRI with fat saturation technique.

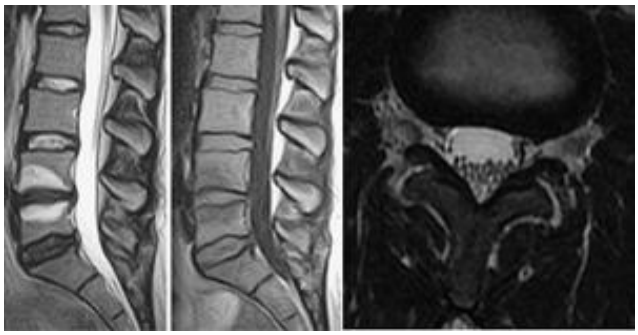

Figure 1: T2-T1 MRI images of lumbar spine showing MC 1 Changes and Grade 2 facet joint degeneration at L4-L5 level showing mild joint narrowing on the left side

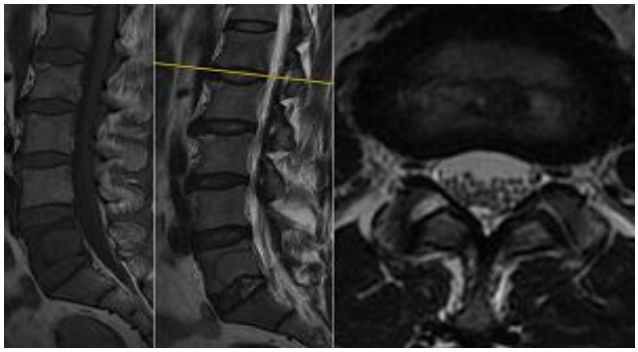

Figure 2: T1-T2 images: Modic type 2 changes with Grade 2 facetjoint degeneration depicting mild joint Space narrowing and osteophyte formation

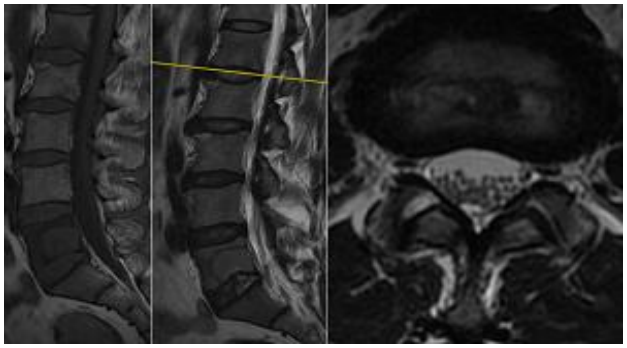

Figure 3: T1-T2 images: Modic type 3 changes with Grade 4 facet joint degeneration depicting subchodral cyst on the right side

Using MRI, compression of the thecal sac, compression of nerve roots, inflammation of the surrounding soft tissues, and the fat–filled neuroforamen can also be assessed simultaneously. There are only few studies[7,8] in the literature which have demonstrated relation between MCs and lumbar facet joint degeneration. Therefore, in this retrospective MRI study, we evaluated facet joint degeneration using Pathria's criteria[6,] in the patients with MCs and without MCs. MCs were found to have the highest incidence in the L4–5 segment. Type 3 MCs had a higher incidence than type I and type 2. MCs irrespective of the level of the lumbar spine involved. MCs were more frequently distributed in grades 1, 2, and 3 of the degenerative lumbar facet regardless of whether they were in the L3–4, L4–5, or L5-S1 segment. Particularly, type 3 MCs were frequently distributed in grades 1, 2, and 3 of the facet joint in the L4–5 and L5-S1 segments.

5. Conclusion

Facet joint degeneration is the cause of low backache in patients with MCs in their lumbar spine. The study suggests that, in such patients, the therapy for the joint degeneration may be helpful in alleviating the chronic low backache.

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