



ORIGINAL ARTICLE

To Interpret the Association of Chronic Low Back Pain with Modic Changes in MRI of Lumbar Spine Degeneration

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Abstract

Modic alterations are variations in the strength of the spinal bone marrow signal on magnetic resonance imaging (MRI), which are frequently linked to degenerative disc disease (DDD). This study's goal is to ascertain if lumbar disc degeneration and modic alterations in patients with persistent low back pain are related on magnetic resonance imaging. This study looked for the presence of modic alterations in degenerative disc diseases in 108 lumbar disc degeneration patients who volunteered for MRI of the lumbar spine for persistent, chronic low back pain. The result of our study are modic changes were associated with chronic low back pain. Type I modic changes are more commonly linked to acute inflammation and pain. Type 2 modic changes are associated with chronic inflammation. Type 3 modic changes are associated with advanced degenerative and sclerotic changes. Thus the conclusion of this study shows that modic changes more frequently at the end plates of lower Lumbar vertebrae at L4-L5 Level and L5-S1 level. Modic changes are complex phenomenon, occurred at multiple level more frequently with increasing in age suggesting these changes are degenerative disc diseases.

Keywords: MRI, Modic Changes, Degenerative disc disease


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Graphical Abstract

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Introduction
Modic alterations are variations in the strength of the spinal bone marrow signal on magnetic resonance imaging (MRI), which are frequently linked to degenerative disc disease (DDD). This study's goal is to ascertain if lumbar disc degeneration and modic alterations in patients with persistent low back pain are related on magnetic resonance imaging. This study looked for the presence of modic alterations in degenerative disc diseases in 108 lumbar disc degeneration patients who volunteered for MRI of the lumbar spine for persistent, chronic low back pain.

Modic changes Type 1



Materials and Methods
The result of our study are modic changes were associated with chronic low back pain. Type 1 modic changes are more commonly linked to acute inflammation and pain. Type 2 modic changes are associated with chronic inflammation. Type 3 modic changes are associated with advanced degenerative and sclerotic changes. Thus the conclusion of this study shows that modic changes more frequently at the end plates of lower Lumbar vertebrae at L4-L5 Level and L5-S1 level

Conclusions
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Introduction

The healthcare system is greatly impacted by the incapacitating illness known as chronic low back pain [1]. Degenerative vertebral disc disease is linked to chronic low back pain (LBP), which can even occur in asymptomatic people. This emphasizes how crucial it is to correlate imaging results with clinical symptoms [2].

Degenerative vertebral disc disease includes herniated vertebral disc disease and degenerative alterations to the vertebral end plate [2]. Because of its abundance of neural components, the vertebral endplate, which serves as a thin contact between the disc and bone marrow [3], has the potential to cause discomfort [4]. For a definitive diagnosis of spinal disorders and low back pain, MRI has remained the gold standard [5]. The intricate interaction between the disc, vertebral body, end plate, and facets joints in the pathophysiology of low back pain

has drawn a lot of interest since the invention of MRI [6].

Twenty-five years ago, De Ross and Modic described three different kinds of spinal marrow signals. Alterations on magnetic imaging resonance next to the end plate⁽⁸⁾. Sagittal spine echo is part of the MRI spine. Bone marrow edema can be seen by T1 rapid spin echo, T2 weighted imaging, T2 (sagittal and coronal) STIR (fat saturation), and T1 and T2 sequence for nerve root compression [9]. The following is the modic categorization. Type 1: linked to edema and inflammation in the vertebral end plate; the vertebral end plate appears hypointense on T2 weighed image and hyperintense on T1 weighted imaging Type 2: fatty replacement of the vertebral end plate and marrow, which manifests as a hyperintense signal of the vertebral end plate on T1 & T2 weighed images; Type 3: area of low signal of the vertebral end plates on both T1 and T2 weighted images [10]. The modic changes in spinal imaging

aid in diagnosis of degenerative spinal conditions, guides treatment decision such as surgical intervention or pain management strategies [11].

Material and Methods

This study was conducted in the Department of Radiology and Orthopedics at Aarupadaiveedu Medical College and Research Institute. The design of study is cross-sectional longitudinal study. The data of the patients were collected who had chronic low back pain subjected to MRI of lumbosacral spine caused by lumbar degenerative disease from MAY 2023 to April 2024. The 1.5 Tesla Philips MRI machine was used for the studies. TR/TE time of 650/22 milliseconds were used to generate the T1 and T2 weighted (sagittal and axial) sequences, and 2600/90 was used to obtain the T2 weighted pictures. For T1 and T2, the acquisition matrix was 192x256 and 256x256, respectively, with a field of view of 260 mm (pixel size: 1.02 mm). For the sagittal picture, the slice thickness and inter-slice gap were 4 mm and 0.4 mm, whereas for the axial slice, they were 3 mm and 0.3 mm.

Image Evaluation

Each of the MRI lumbosacral image was evaluated in detail for the presence and type of modic changes in the lumbar spine, starting with sagittal T1w images and moving on to T2w sagittal and axial images that were correlated for modic changes. The patients' MRI scans were reviewed from the electronic images

on the MRI machine's computer system. All images were described by an experienced radiologist in accordance with a set spiral imaging protocol.

Modic classification as follows Type 1; vertebral end plate was hyperintense signal on T2 weighted images and hypointense signal on T1 weighted imaging characterising acute inflammation, edema and bone marrow changes, Type 2; hyperintense signal of vertebral end plate on T1 & T2 weighted image characterising chronic degenerative changes, fatty replacement and bone marrow changes, Type 3; area of low signal of vertebral end plates on both T1 and T2 Weighted image characterising advanced degenerative changes, sclerotic changes and bone thickening [11].

Results

The baseline study population consist of total 108 with chronic low back pain in lumbar degenerative disc disease. Out of 108 cases, 52(48%) were male and 56(52%) were female, 97(89%) had modic changes present and 11 individuals did not have any modic changes.

Among the end plate with modic changes 10 were Type I, & 76 were Type II being the most common type on our sample and 11 were of Type III modic changes. In 108 study participant below 30 age group (Male 2, female 2), 31-40 age group (Male-9, female 13) 41-50 (male-18, Female- 13), 51-60 age group (male-10, female-17) Above 60 (male-13, female-11) (Figure 1 to 4; Table 1).

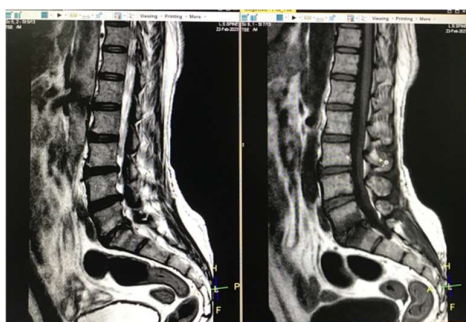


Figure 1. Modic changes Type 1



Figure 2. Modic Type 2

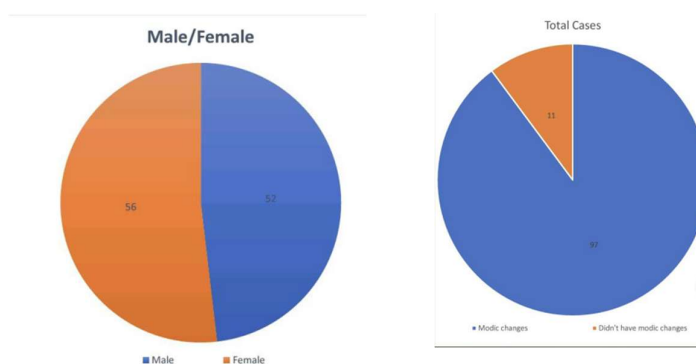


Figure 3. Modic Type 3

Table 1. Age-Wise Representation of Modic Changes

SEX	below 30	31-40	41-50	51-60	above 61	total
male	2	5	18	10	13	48
female	2	6	13	17	11	49
	4	11	31	27	24	97

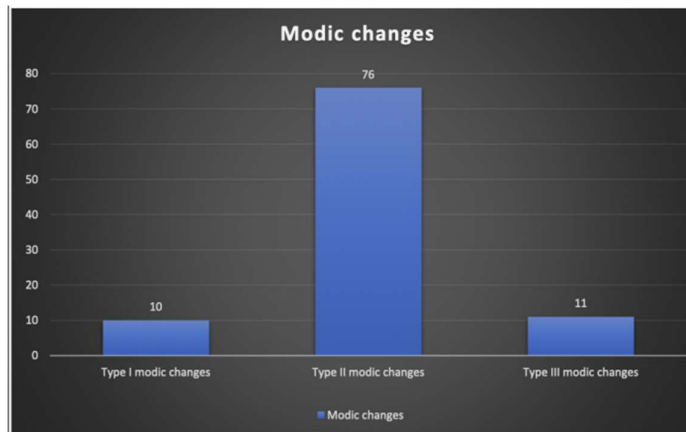


Figure 4: Graphic Representation of Modic Changes

In total 97 participant, vertebral end plates with modic changes, L2/L3-(10 end plates), L3/L4-(17 end plates), L4/L5 (38 end plates), L5/S1-(32 end plates).

There was significant relationship between the disc level and the presence of modic changes ($P < 0.01$), the presence of modic changes was highest at L4/L5 level and L5/S1 level out of 108.

Discussion

As a result, our study demonstrates that in patients with chronic low back pain who have degenerative lumbar vertebral disease, modic alterations occur more commonly at the end plate. According to the study, 89% of the 108 patients with chronic low back pain who had degenerative illness had modic alterations.

Modic alterations are typical in middle-aged people but rare in children and young adults. According to the current study, there is a correlation between growing older and the occurrence of morphic alterations. In our study, end plates that were older than 40 years had a higher frequency of high frequency (58%).

The two the superior and inferior lumbar vertebral end plates were found to

be impacted by the modic alterations in this investigation. Among the various lumbar segments, the distribution of modic alterations mostly took place in the bottom two lumbar levels.

The Lower Lumbar Vertebra (L4-L5 and L5-S1) is the most common, according to the study. Compared to the upper lumbar spine, the lower lumbar levels would be more likely to withstand the increased mechanical loading. Males with modic alterations were more prevalent than females. Males are more likely than women to engage in moderate to heavy physical labor, which puts larger repetitive stress loads on the lumbar spine [10]. Women will see more modic alterations, which may be related to osteoporosis brought on by hormone fluctuations. In this study, modic type II was the most prevalent, whereas modic types I and III had roughly Equal frequency

The modic changes occurred at multiple levels more frequently with involving the age suggesting these changes are degenerative. End plates is thin interference between bone marrow and disc and is rich in neural elements ,if any

loss of its integrity leads to degenerative events and probable cause of pain generators. Modic changes can be a useful diagnostic marker, however they should be considered in conjunction with clinical symptoms and other diagnostic findings for chronic back pain in patients with degenerative disc diseases.

Conclusion

This study shows that modic change more frequently at the end plates of lower lumbar vertebrae at L4-L5 level and L5-S1 level. Type II was the most common and modic Type I and Type III had more or less equal prevalence. Modic changes occurred at multiple level more frequently with increasing in age suggesting these changes are degenerative in nature. Thus the modic changes in spinal imaging aid in diagnosis of degenerative spinal conditions guide treatment decision such as surgical intervention or pain management strategy

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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