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Study of lumbar spine by MRI with special reference to disc degeneration and Modic changes in rural area

Raviraj Durganand Walwante[1], Shankar Sambhajirao Dhapate[2,*], Satishkumar Sukhanand Porwal[3]

[1,3]Assistant Professor, [2]Professor & HOD, Dept. of Anatomy, SRTR Govt. Medical College, Beed, Maharashtra

***Corresponding Author:**
Email: walwanteraviraj@gmail.com

Abstract

Introduction: Degenerative disease of the lumbar spine refers to a syndrome in which an intervertebral disc with adjacent spine structures is compromised; this can be due to aging process associated with pathologic process. Individuals with degenerative disease of the lumbar spine can be symptomatic or asymptomatic, although commonly the disease is asymptomatic. The symptomatic individuals can present with back pain or radicular pain syndrome (sciatica). Lumbar spine is the common area affected by degenerative changes, as it is a part of spine which is subjected to heavy mechanical stress. This disease encompasses disc degeneration, Modic changes, disc displacement, facet joint arthropathy and associated complications.

Materials and Method: This is a hospital based cross-sectional descriptive study. Study population included all patients above 20 years of age with lower back pain with/without radiculopathy who were referred for lumbar spine MRI at Radiology department.

Observations and Result: The study included 165 patients; the age range was from 20 to 80 years whereby eighty-two of them were females. On lumbar MRI, overall prevalence of lumbar degenerative findings was 91%. Disc degeneration (sign of reduced disc signal intensity) being the most frequent finding seen in 91% patients and Modic changes in 38%. Minority of participants (9%) had normal lumbar MRI findings. Most of the degenerative findings were seen at lower lumbar levels i.e. L4/L5.

Conclusion: In this study we have studied different pattern of degenerative changes in lumbar spine by MRI and association between low back pain and degenerative changes.

Keywords: Back pain, disc degeneration, Modic changes, disc displacement, nerve root compression, spinal canal stenosis, MRI.

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Introduction

Degenerative disease of the spine is a worldwide problem. Its prevalence increases with age. It ranges from 85% to 95% among adults aged 50 to 55 years, with no sex difference.[1-3] Hult estimates that up to 80% of population is affected by this symptom at some time in life.[4] Degenerative disease of the lumbar spine refers to a syndrome in which an intervertebral disc with adjacent spine structures is compromised; this can be due to aging process associated with pathologic process.[5] Individuals with degenerative disease of the lumbar spine can be symptomatic or asymptomatic, although commonly the disease is asymptomatic.[6-8] Back pain is strongly associated with degeneration of the intervertebral disc.[7] The symptomatic individuals can present with back pain or radicular pain syndrome (sciatica).[9] The possible sources of pain are mechanical compression of neural elements by disc herniation, as well as direct biochemical and inflammatory.[1,9] Asymptomatic individuals may have degenerative spine findings, including: disc degeneration, Modic changes, disc bulges, facet joint arthropathy and spinal stenosis.[6-8]

Modic changes are pathological changes in the vertebrae. These changes are situated in both the body of the vertebrae and in the end plate of the neighbouring disc. Modic changes are characterized on MRI (magnetic resonance imaging). The Modic changes were first described and defined by Dr. Michael Modic in 1988.[1] Normal bone contains internal scaffolding called trabeculae. Red bone marrow is located in the hollows between the trabeculae. In Modic type 1 there is vascular development in the vertebral body, with findings of inflammation and edema, but no trabecular damage or marrow changes. In Modic type 2 there are changes in bone marrow, with fatty replacement of formerly red, cellular marrow normally seen there. With Modic type 2 changes the marrow is substituted by visceral fat, the same kind of fat we have on our hips and bellies. Modic Changes type 3 are less common, with fractures of the trabecular bone, along with trabecular shortening and widening. Ageing is main factor implicated in spine degenerative disease.[1] Apart from age other factors have been implicated as causes of spine degenerative disease, these include; genetic inheritance, physical loading history, trauma and impaired nutrition.[5,10] Lumbar spine is the common area affected by degenerative changes, as it is a part of spine which is subjected to heavy mechanical stress.[11]

Despite the ambiguous relationship between anatomy and pain, clinicians rely heavily on medical imaging to identify patho-anatomic changes. The role of diagnostic imaging in spine degenerative disease is to evaluate the status of the neural tissues and to affect the therapeutic decision making.[12] Imaging is only justified in patients for whom surgery is considered. The commonly used imaging modalities are x-ray, CT and MRI. Plain film examination of the lumbar spine is the usual initial imaging technique.[13] Plain radiography provides only limited diagnostic information because it cannot show the structural

morphology of the intervertebral disc. MRI has become the primary imaging modality for evaluation of degenerative disorders of lumbar spine. The intervertebral disc, vertebrae, ligaments, spinal canal and neural foramina may also be best evaluated using current MRI techniques. In this study the anatomical cross-sectional imaging and disco-graphic findings of patients who are referred for MRI for low back pain will be reviewed.

Materials and Method

This is a hospital based cross-sectional descriptive study. Study was done for estimating pattern of degenerative changes seen in patients with low back pain referred to lumbar magnetic resonance imaging centre located in rural area. A total of 175 individuals had lumbar MRI scan in a year. Only 165 who fulfilled the study criterion were studied. Those patients above 20 years of age, with history of low back pain with/without radiculopathy were included in this study. Those patients having history of former lumbar spine surgery, vertebral trauma, and spine tumour, spine infection and Modic type 3 which is less common finding were excluded form study. Permission to conduct the study at Radiology department was obtained from authority. Imaging was performed by a trained Radiographer. Lumbar spine MRI was done using 0.03OTscanner (XinAoMDT). The findings assessed on MR imaging were disc degeneration and Modic change. The clinical condition of the subjects collected from data was compared with the imaging findings. Data analysis was done by using the software statistical package for social sciences (SPSS) software and using Open Source epidemiological statistics for public health version 2.3.1.

Observations and Results

The study included 165 patients, the age range was from 20 to 80 years (mean; 47.49± 14.33 years) whereby 82 of them were females and 83 were males (Table 1).

Table 1: Shows age group and sex of patients included in study

Age in years	Sex		Total
	Male	Female	
20-39 years	33	28	61
40-59 years	29	37	66
60-80 years	21	17	38
Total	83	82	165

On lumbar MRI, overall prevalence of lumbar degenerative findings was 91%, disc degeneration (sign of reduced disc signal intensity) being the most frequent finding seen in 150(90.9%) patients, followed by Modic changes 63(38.18%) (Fig. 1, 2). Minority of participants 15 (9.09%) had normal lumbar MRI findings (Fig. 3).

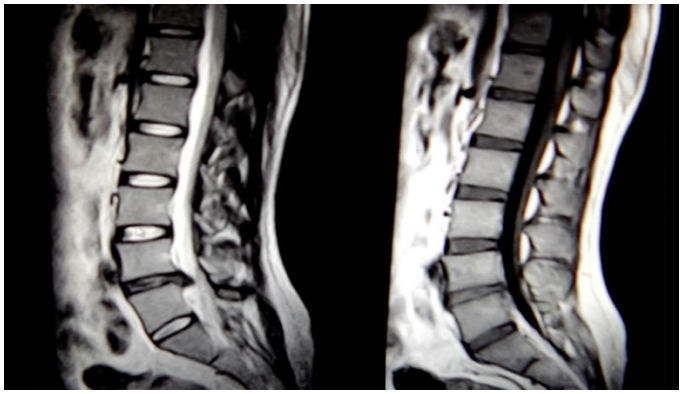

Fig. 1: Shows degenerative changes with disc herniation at L4/L5 intervertebral disc

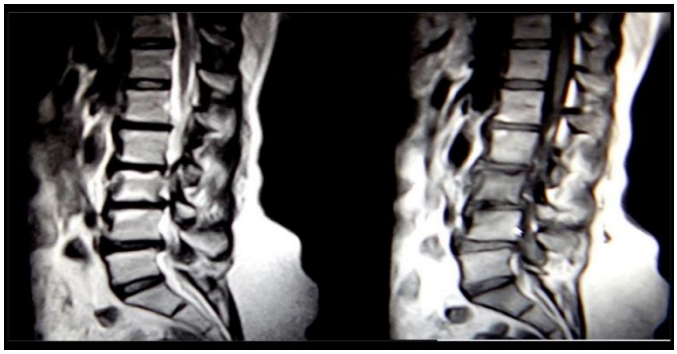

Fig. 2: Modic changes at end plates of lumbar vertebrae

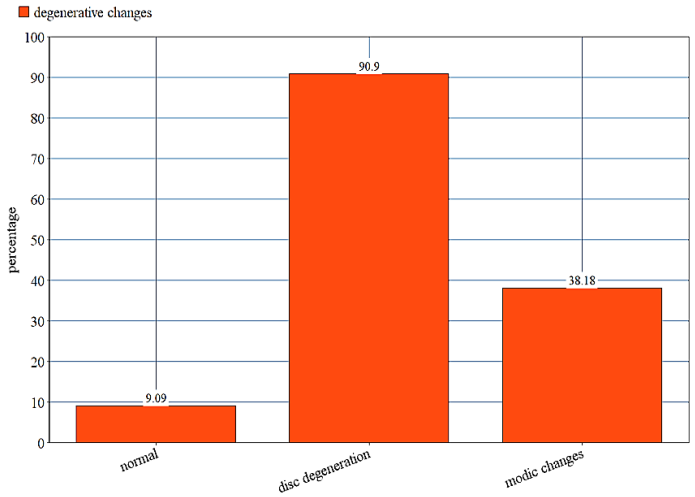

Fig. 3: Graphical presentation of degenerative findings

The prevalence of lumbar degenerative findings was increasing with age. All patients aged 60 to 80 years had degenerated discs, whereby in 20 to 39 years and 40 to 59 years of age, prevalence was 81.96% and 93.93% respectively. This was also true for Modic changes. Type I Modic changes were more common than type II with prevalence of 22% and 15% respectively (p-value: 0.264) (Table 2).

Table 2: Degenerative findings in different age group.

Sr. No	Findings	Age (In Years)			Total (N=165)	P Value
		20-39 (n=61)	40-59 (n=66)	60-80 (n=38)		
1	Disc Degeneration	50(81.96)	62(93.93)	38(100)	150(90.90)	0.005
2	Modic Changes	15(24.59)	24(36.36)	24(63.15)	63(38.18)	0.000
	Type –I	10(16.39)	16(24.24)	11(28.94)	37(22.42)	0.264
	Type – II	5(8.19)	8(12.12)	13(34.21)	26(15.75)	

Prevalence of various degenerative imaging findings was more common among males but Modic changes was common among females, though the differences were not statistically significant (p-value ≥0.05) (Table 3).

Table 3: Degenerative findings in different sex

Sr. No	Findings	Sex			P- Value
		Male (n=83)	Female (n=82)	Total (N=165)	
1	Disc Degeneration	76(91.56)	74(90.24)	150(90.90)	0.767
2	Modic Changes	22(26.50)	41(50)	63(38.18)	0.001
	Type –1	16(19.27)	21(25.60)	37(22.42)	0.098
	Type – 2	6(7.22)	20(24.39)	26(15.75)	

Most of the degenerative findings were seen at lower lumbar levels i.e. L4/L5 and L5/S1, 38.82% and 29.30% respectively. At L4/L5 the prevalence of disc degeneration and Modic changes, were 112(67.87%) & 42(25.25%) respectively, whereby these findings at L1/L2 were 63(38.18%) & 3(1.81%) respectively (Table 4).

Table 4: Degenerative findings at different disc level

Disc Level	Degenerative Image Findings (N=165)	
	Disc Degeneration	Modic
L1-L2	63(38.18)	3(1.81)
L2-L3	68(41.21)	4(2.42)
L3-L4	79(47.87)	12(7.27)
L4-L5	112(67.87)	42(25.25)
L5-S1	113(68.48)	20(12.12)

Prevalence of disc degeneration and Modic changes in patients with low back pain and radiculopathy was 69(93.24%) & 32(43.24%) respectively. Prevalence of disc degeneration and Modic changes in patients with only low back pain was 81(89.01%) & 31(34.06%) respectively (Table 5).

Table 5: Degenerative findings in symptomatic patients

Findings	Symptoms		
	LBP with Radiculopathy (n=74) (44.84%)	LBP Only (n=91) (55.15%)	P Value
Disc Degeneration	69(93.24%)	81(89.01%)	0.884
Modic Changes	32(43.24%)	31(34.06%)	0.228

(LBP= Low Back Pain)

Discussion

The role of diagnostic imaging is to provide accurate anatomical information and to affect the management decision making.[2] This cross-sectional hospital based study used MRI to diagnose spine degenerative changes as it has better tissue segregation and it can show degenerative changes at an early stage as compared to other imaging techniques (such as CT scan).[12] Other advantage of MRI includes having no known side effects or morbidity, no radiation exposure and is non-invasive.[12,14,15] Despite its high sensitivity, degenerative changes are observed on many MRI scans in asymptomatic subjects, thus questioning its specificity.[14] That's why MRI is only beneficial to patients with chronic disease and those who are being planned for spine surgery.

All selected patients underwent MRI of the lumbar spine and both sagittal and axial views of all images were interpreted to locate the degenerative findings. Degenerative changes were observed in majority 150 (90.90%) of patients examined. Most of these degenerative findings were seen at L4/L5 and L5/S1. Though a degenerative change of the disc begins early in life and is partly a consequence of aging, the actual cause is not known but many factors (autoimmune, genetic, re-absorption and biochemical) have been implicated in accelerating the process. Since lumbar spine is subjected to heavy mechanical stress, it is a common area affected by degenerative changes[16] this could partly explain such observation in this study group. The mean age of this study group is 47.49± 14.33 years, could be another explanation, as degenerative changes is common in individuals above 40 years of age and its prevalence increases progressively to over 90% by 50 to 55 years of age.[17-19]

Disc degeneration was the most frequent finding observed in 150(90.90%) patients in this study. The prevalence was observed to increase with age (60 to 80 years of age was 100%, whereby in 40 to 59 and 20 to 39 years of age was 93.93% and 81.9% respectively). The difference observed between the age groups was significant (p-value= 0.005) and compares with the findings of other previous studies.[3,17-19] The prevalence of disc degeneration to young individuals (20 to 39 years) could probably be explained as results of genetic predisposition; though, other factors like repeated traumatic injuries and physical loading history can play a role in causing disc degeneration.[3,8,17,19] The difference in prevalence among young and aged individual could be contributed by aging process. Though In this study MRI has revealed high frequency of lumbar degenerative imaging findings; MRI may also reveal high rates of abnormalities in asymptomatic individuals.[14] Because of these findings among asymptomatic individuals, MRI alone cannot be used to define the cause of symptoms among symptomatic patients. MRI findings must be correlated with patient age, clinical signs and symptoms following a careful physical examination for accurate management decisions.

Conclusion

There is a strong association between low back pain and degenerative changes in lumbar spine observed on MRI. Degenerative changes in lumbar spine increase with age, being more common among males than females. Disc degeneration is the most frequent finding followed by Modic changes. Degenerative changes occur more frequently at lower lumbar levels (L4/L5, L5/S1).

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