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Original Article

Magnetic Resonance Imaging Evaluation of Lumbar Degenerative Disc Disease with Clinical Correlation

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Abstract

Introduction: Degenerative disc disease includes a wide spectrum of degenerative abnormalities. Low back pain secondary to degenerative disc disease is a condition that can affect young to middle-aged persons. In degenerative diseases intervertebral disc with adjacent spine structure are compromised. Magnetic resonance imaging (MRI) allows complete evaluation of static and dynamic factors related to degenerative disease of the spine.

Aims and Objectives: The aim of the study was to describe various MRI features of degenerative disc disease of lumbar spine (LS). Correlation of disc changes with clinical findings.

Materials and Methods: Design of study: This will be non-randomized observational cross-sectional study. Study period March 2017–August 2018. Source of data: NSCB Medical College Jabalpur.

Method of Collection of Data: Patients presenting to clinical departments with low back ache with or without radiating pain to one or both thigh and who undergo MRI will be taken. MRI LS will be done on GE health-care Sigma 1.5 T MRI scanner.

Observation and Results: The study included 165 patients, the age range was from 18 to 80 years (mean; 50 ± 12.5 years) whereby 87 (53%) of them were females. Disc degeneration being the most frequent finding seen in 137 (83%) patients, followed by nerve root compression 127 (77%), disc herniation 104 (63%), disc bulge 64 (39%), and central canal stenosis 50 (30%).

Conclusion: Disc desiccation was the most frequent finding followed by nerve root compression. The least finding was Modic changes, whereby Type 2 was more common than Type 1. Disc protrusion was the most common type of herniation and was commonly located posterolaterally. Prevalence of degenerative findings was increasing with age ($P < 0.05$), being more common among males than females, though the difference was not statistically significant ($P > 0.05$).

Key words: Disc protrusion, Herniation, Magnetic resonance imaging

INTRODUCTION

Degenerative disc disease includes a wide spectrum of degenerative abnormalities. Low back pain (LBP) secondary to degenerative disc disease is a condition that can affect young to middle-aged persons. In degenerative diseases, an intervertebral disc with adjacent spine structure is compromised. Magnetic resonance imaging (MRI) allows a complete evaluation of static and dynamic factors related to degenerative disease of the spine and is useful in diagnosing the different aspects of spine degeneration.[1]

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Aims and Objectives

The aims of the study are as follows:

1. To describe various MRI features of degenerative disc disease of lumbar spine (LS).
2. Correlation of disc changes with clinical findings.
3. To assess associated abnormalities.

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Normal Anatomy

The signal intensity of vertebral bodies depends on amount and type of marrow present. Normally, the proportion of red to yellow marrow is high so that vertebral bodies show medium to high signal with Type 1 weighted (T1W) and intermediate to low signal with T2W.

Intervertebral Dics

Demonstrate low signal on T1W and high signal on T2W.

Spinal Ligaments

Most ligament (except ligamentum flavum) demonstrated low signal similar to bone on all imaging sequence.

The ligamentum flavum demonstrated intermediate signal on T1W and T2W sequence and high on gradient echo sequence.

Spinal Cord and Nerves

The AP diameter of the cord is 9–10 mm throughout its length.

Spinal cord has an intermediate signal on T1 and low signal on T2W sequence.

Causes of LS Degenerative Disease

Aging is the main factor implicated in spine degenerative disease.

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.[1,2]

Types of Spine Degenerative Disease

This disease encompasses disc degeneration, Modic changes, disc displacement, facet joint arthropathy, and associated complications (nerve root compression and spinal canal stenosis).[3]

Disc degeneration

Disc degeneration is a loss of disc signal on T2W images with/without disc height reduction[1] [Figure 1].

The dark signal of the disc on T2W images is due to loss of water content. Initially, there are biochemical changes within a disc, resulting in dehydration of disc.[1]

Modic changes

Modic changes are endplate degenerative changes due to disc degenerative disease.[4] These are signal intensity changes shown adjacent to the endplates of the degenerated intervertebral discs in MRI.[1,5] They are assumed to be a specific phenotype of degenerative disc disease.[1] These Modic changes can be painful - especially Type 1 changes. [1] They are common observation on MRI and are of three main forms.[1] Type 1 is the acute stage of disc disease; there is an invasion of the cancellous spaces by fibrovascular reactive tissue.[6,7] With time, fatty replacement of red marrow occurs leading to Type 2 Modic changes [Figure 2]; eventually bony sclerosis of the marrow occurs and leads to Type 3 Modic changes.[6,7]

Disc displacement

Disc displacement is also one of the findings in spine degenerative disease. The displaced disc can be a simple bulge, protruded, extruded, or sequestration.[3]

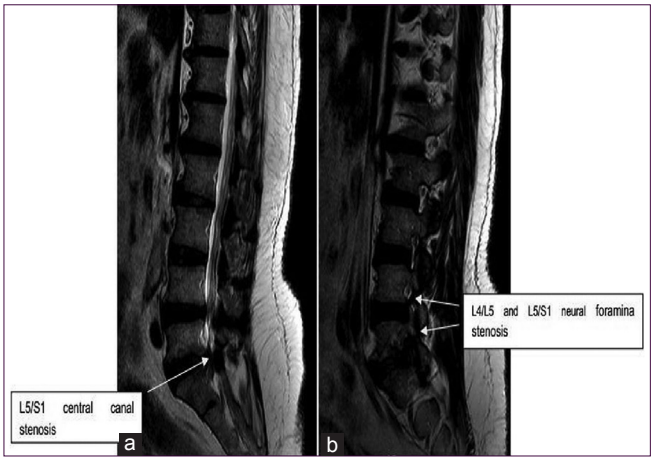

Figure 1: Multilevel disc degeneration, disc bulge, central and exit neural foramina stenosis in a 58 years old male patient referred for lumber magnetic resonance imaging at NSCB Medical College, (a) T2 weighted (T2W)-mid saggital: All discs have low signal (low water content/desiccated), disc bulge seen at L4/L5 and L5/S1, central canal stenosis is seen at L5/S1. (b) T2W-parasaggital, showing severe exit neural foramina stenosis at L4/L5 and L5.S1

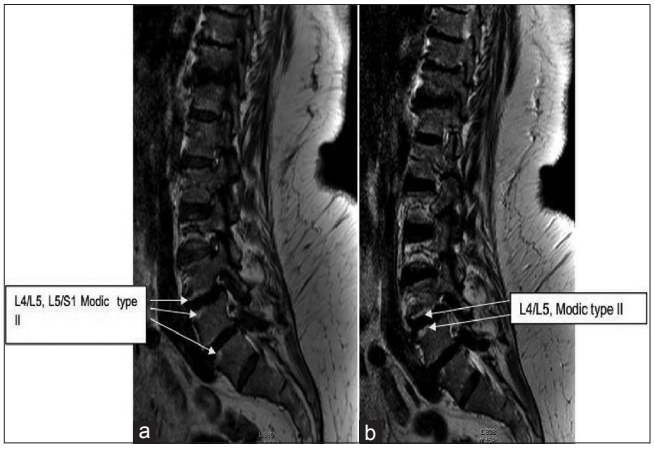

Figure 2: Disc degeneration, Modic change type II, disc protrusion and exit nerve compression in a 68 years old female reffered for Lumbar magnetic resonance imaging at BSCB Medical College. (a) Sagittal T1 weighted (T1W): Showing endplate bright signal at L4/L5 and upper anterior endplate of S1. (b) Sagittal T1W: Multilevel disc degeneration are seen (low signal of discs signifyingdessication), bright signals at endplates of L4/L5 and upper endplate of S1

Disc bulge

Is a circumferential enlargement of the disc contour in a symmetric fashion in a weakened disc, the annulus is intact with disc extension outward involving >50% of disc circumference or diffuse (nonfocal, nonosseous material extending beyond the normal disc space in a circumferential manner.[7,8]

Disc herniation

Is a localized/focal displacement of disc beyond the intervertebral disc space.[9] A herniated disc can be protruded, extruded, or sequestrated.[3]

Disc protrusion

It is a focal displacement disc material beyond margins of adjacent vertebral endplates involving <50% of disc circumference.[10]

Extrusion

Is a herniated disc in which, has a small connection with the parent disc (narrow neck).

Sequestration (free disc fragment)

Is a piece of disc tissue belonging to the disc material, moving separately from and having no connection with the main disc, migrating within the spinal canal cavity.[11]

Central spinal canal stenosis

Spinal stenosis is defined as loss of signal in epidural fat with compression of neural tissues within the canal.[4,11] Spinal stenosis is evident when there is a reduction of spinal canal diameter to <12 mm. The normal size of the lumbar spinal canal is 15–27 mm. Spinal canal stenosis commonly presents between 30 and 50 years of age.[10] Degenerative lumbar changes cause spinal stenosis [Figure 3].

Imaging

Prevalence of disc degeneration

Disc degeneration is common in individuals who are >40 years of age through its prevalence increases progressively to over 90% by 50–55 years of age.[10]

The most common spine levels for disc degeneration are at L4/L5 and L5/S1.[12,13] In many studies, no association has been developed between disc degeneration and LBP although Filiz *et al.* 10 observed a higher prevalence of disc degeneration among symptomatic individuals as compared to asymptomatic ones (55.5% and 33.3%, respectively). Cheung *et al.*[13] reported a significant association between lumbar disc degeneration on MRI and back pain.

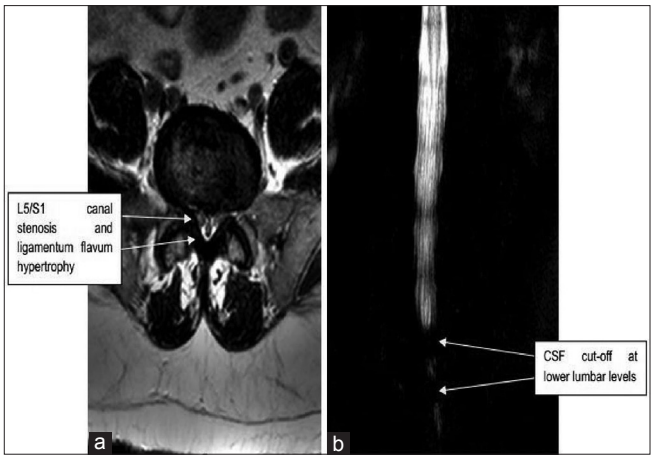

Figure 3: Images of the patient as (a) T2 weighted-axial view, showing severe central canal stenosis at L5/S1. Note the facet joint and ligamentum flavum hypertrophy at this level (b) magnetic resonance-myelogram showing cerebrospinal fluid blockage at lower levels due to central canal stenosis

Prevalence and types of Modic changes

The prevalence of Modic changes ranges from 18% to 58%. Modic changes are common in patients with LBP and strongly associated with LBP.

Prevalence, types, and location disc displacement

Disc displacement is also one of the findings in spine degenerative disease. The prevalence of disc herniation ranges from 60% to over 90%. Among young adults the prevalence of disc herniation is low. This has been reported by Takatalo *et al.*[14] to be <1% among individuals aged between 20 and 22 years.

Most common location for disc herniation is posterolateral (49%).[10] This is due to weak points along the posterolateral margin of the disc at the lateral recess of spinal canal. Other locations include posterocentral (8%), lateral or foraminal in <10%.[10] Extraforaminal or anterior account for 29%. This location is commonly overlooked. Intraosseous disc herniation accounts for 14% which is also known as vertical herniation or Schmorl node.[10]

Takarad *et al.*[15] observed that nearly 93% of disc herniations occur inside the spinal canal (intraspinal), 3% are predominantly in the intervertebral foramen, and 4% are extraforaminal or occur far laterally. Central herniation is not common due to the presence of strong ligament.[10]

Prevalence of spinal stenosis and nerve root compression

Spinal stenosis is also one of the findings in degenerative changes, and it is more common in patients with sciatica than in patients with LBP. Shobeiri *et al.*[16] reported the prevalence of 37% among patients with sciatica and 11% among patients with LBP ($P < 0.001$).

MRI

Imaging was performed by a trained radiographer. LS MRI was done using 1.5 T Scanner. The scans consisted of sagittal and axial T1W (repetition time/echo time [TR/TE] of 400/8 ms) and T2W (TR/TE of 3000/120 ms) turbo spin echo and short tau inversion recovery (STIR) images. The slice thickness of 4 mm was used for both sagittal and axial images. The interslice gap of 0.4 mm used with 332 × 240 matrix and a field of view of 300 mm were used for sagittal images, and 224 × 168 matrix and a field of view of 200 mm for axial images. The variables assessed on MRI were: Disc degeneration, Modic.

Classification of disc degeneration on sagittal T2W MRI.[17]

Grade	Differentiation of nucleus from annulus fibrosus	Signal intensity of nucleus pulposus	Disc height
1	Yes	Homogeneously hyperintense	Normal
2	Yes	Hyperintense with horizontal dark band	Normal
3	Blurred	Slightly decreased, minor irregularities	Slightly decreased
4	Lost	Moderately decreased, hypointense zones	Moderately decreased
5	Lost	Hypointense, with or without horizontal hyperintense band	Collapsed

Modic changes were evaluated in accordance with the system described by Modic,[3] as follows;

- Modic change Type 1: Low signal intensity on T1W images and high signal intensity on T2W and STIR images when compared with normal fatty bone marrow,
- Modic change Type 2: High signal intensity with both T1W, T2W, and low signal on STIR images,
- Modic change Type 3: Low signal intensity on T1W and T2W images.

Disc bulge: Evaluated as presence or absence of disc bulge.

Disc herniation (protrusion and extrusion sequestration): Evaluated as a presence or absence of disc herniation.

Central Spinal canal stenosis, grading criterion for spinal canal stenosis by Borenstein *et al.*

Normal	Round shape of spinal canal
Mild	Flattening of the ventral thecal sac
Moderate	Triangularization of the spinal canal with loss of the posterior epidural fat pad
Severe	Compression of the canal with loss of epidural fat in all planes

Nerve Root Compression

Nerve root compression at any location (i.e., thecal sac, lateral recess, or foramen) was just noted as presence or absence of nerve root compression.

MATERIALS AND METHODS

Design of Study

This will be non-randomized observational cross-sectional study.

Study period

1st March 2017 to February 2018.

Study center

This study was conducted at the Department of Radiodiagnosis, NSCB Medical College and Hospital Jabalpur, Madhya Pradesh, India.

Source of Data

Data were from NSCB Medical College and Hospital Jabalpur, Madhya Pradesh, India.

METHOD OF COLLECTION OF DATA

Patients presenting to clinical departments with low back ache with or without radiating pain to one or both thigh and who undergo MRI will be taken. MRI LS spine will be done on GE health-care Sigma 1.5 T MRI scanner.

Sample Size

In present intended study is a non-randomized observational cross-sectional study carried out on 165 patients visiting the Outpatient Department/ Inpatient Department refered to MRI scan to the Department of Radiodiagnosis NSCB Medical College Jabalpur, Madhya Pradesh, India.

Sampling and Sample Size

A total of 165 whom fulfilled the study criterion were studied. The sample size was calculated from the formula: $n=Z^2P(1-P)/E^2$ Where,

n=Sample size, Z=(1.96).

P=Prevalence=11%. This was the prevalence the of degenerative spinal canal stenosis among patient with LBP.[28]

95% confidence interval was used. E=Error margin 5%.

$$\text{Therefore } n = \frac{(1.96)^2 \times 0.11(1-0.11)}{(0.05)^2}$$

n=150+15 (10% 0f 150), so the sample size in this study was 165 patients.

Inclusion Criteria

The following criteria were included in this study:

- All patients presenting with low backache and with or without radiculopathy >18 years age.
- All patients referred from clinicians suspecting degenerative disease of LS.
- Patients with lumbar degenerative disease with bowel and bladder involvement.

Exclusion Criteria

The following criteria were excluded from this study:

- Patient with history of acute trauma, surgical intervention infection, tumors and tumors like conditions,
- Patients with contraindication to MRI such as pacemaker, recent coronary stent, cochlear implants, and claustrophobia.

Data Management and Analysis

Data analysis was done using SPSS version 13.[18] Data quality check was done by running frequencies daily. Data transformation by recoding, counting, and cross tabulation was performed and obtained information was processed using Pearson Chi-square and Fisher's exact test to compare MRI findings and patient demographic and presenting symptoms.

Fisher's exact test was used on cells with values <5. ($P = 0.05$) was considered to indicate statistically significant difference.

OBSERVATION AND RESULTS

The study included 165 patients, the age range was from 18 to 80 years (mean; 50 ± 12.5 years) whereby 87 (53%) of them were females on lumbar MRI [Table 1], overall prevalence of lumbar degenerative findings was 94%, disc degeneration (sign of reduced disc signal intensity) being the most frequent finding seen in 137 (83%) patients, followed by nerve root compression 127 (77%), disc herniation 104 (63%), disc bulge 64 (39%), and central canal stenosis 50 (30%). The least common finding was Modic changes which was seen in 47 patients (28%). Minority of participants (6.1%) had normal lumbar MRI findings.

The prevalence of lumbar degenerative findings was increasing with age. All patients aged 60–80 years had degenerated discs, whereby in 18–39 years and 40–59 years of age, prevalence was 43% and 89%, respectively.

This was also true for Modic changes, central canal stenosis, and nerve root compression, ($P = 0.011$, 0.001, and 0.002, respectively). Type 2 Modic changes were more common than Type 1 with prevalence of 22% and 6%, respectively ($P = 0.022$) [Table 2].

For disc bulge, herniation the prevalence varied with age but the differences were not statistically significant ($P > 0.05$) [Table 2].

Prevalence of various degenerative imaging findings was more common among males, only disc bulges were common among females, though the differences were not statistically significant ($P \geq 0.05$) [Table 3].

Most of the degenerative findings were seen at lower lumbar levels, that is, L4/L5 and L5/S1, 42% and 28%, respectively. At L4/L5 the prevalence of disc degeneration, Modic changes, disc bulge, disc herniation, central canal stenosis, and nerve root compression were 109 (66%), 22 (13%), 38 (23%), 78 (47%), 41 (25%), and 107 (65%), respectively, whereby these findings at L1/L2 were; 24 (14%), 3 (2%), 1 (1), 3 (2%), 1 (1%), and 5 (3%), respectively [Table 4].

Nearly 98% of all herniated discs were protrusion. Only 3 (2%) discs were extrusions [Table 5].

The most common location for disc herniation was posterolateral seen in 132 (75%) discs, followed by posterocentral and foraminal 42 (24%) and 3 (2%), respectively, so the intraspinal disc herniation (postcentral and posterolateral) was the most common, seen in 174 (98%) herniated discs [Table 6].

Prevalence of disc degeneration, Modic changes, and disc bulge did not significantly vary with a patient presenting symptoms. Disc herniations, central canal stenosis and nerve root compression, were common in patients with radiculopathy than in patients with LBP only. The prevalence was 100 (76%), 50 (38%), and 118 (89%), respectively, for patient with radiculopathy and 4 (12%), 0 (0%), and 9 (27%), respectively, for patient with LBP only ($P = 0.000$). None of the patient with LBP only had canal stenosis [Table 7].

DISCUSSION

All 165 patients fulfilling inclusion criteria underwent MRI of the LS. The saggital and axial views of all images were interpreted to locate the degenerative findings. Degenerative changes were observed in majority 155 (94%) of patients examined. Most of these degenerative findings were seen at L4/L5 (42%) and L5/S1 (28%). Since LS is

Table 1: Sex-wise distribution

Sex	Number of cases (%)
Male	78 (47.27)
Female	87 (52.73)
Total	165 (100)

Table 2: Distribution of degenerative imaging findings by age

Findings	18–39 years (*n*=30)	40–59 years (*n*=98)	60–80 years (*n*=37)	Total (*n*=165)	*P* value
Disc degeneration	13 (43.3)	87 (88.8)	37 (100.0)	137 (83.0)	0.000
Modic changes	2 (6.7)	31 (31.6)	14 (37.8)	47 (28.5)	0.011
Type I Modic changes	1 (3.3)	6 (6.1)	3 (8.1)	10 (6.1)	0.022
Type II Modic changes	1 (3.3)	25 (25.5)	11 (29.7)	37 (22.4)	0.022
Disc bulge	12 (40.0)	40 (40.8)	12 (32.4)	64 (38.8)	0.664
Disc herniation	14 (46.7)	63 (64.3)	27 (73.0)	104 (63.0)	0.079
Canal stenosis	2 (6.7)	30 (30.6)	18 (48.6)	50 (30.3)	0.001
Nerve root compression	17 (56.7)	77 (78.6)	33 (89.2)	127 (77.0)	0.002

Distribution of patients with degenerative imaging findings by age of *n*=165 (percentages in parenthesis)

Table 3: Distribution of degenerative findings by sex

Findings	Sex			
	Male (*n*=78)	Female (*n*=87)	Total (*n*=165)	*P*-value
Disc degeneration	67 (85.9)	70 (80.5)	137 (83.0)	0.353
Modic changes	26 (33.3)	21 (24.1)	47 (28.5)	0.191
Type I Modic changes	7 (9.0)	3 (3.4)	10 (6.1)	0.246
Type II Modic changes	19 (24.4)	18 (20.7)	37 (22.4)	0.246
Disc bulge	27 (34.6)	37 (42.5)	64 (38.8)	0.298
Disc herniation	54 (69.2)	50 (57.5)	104 (63.0)	0.118
Canal stenosis	24 (30.8)	26 (29.9)	50 (30.3)	0.902
Nerve root compression	63 (80.8)	64 (73.6)	127 (77.0)	0.272

Percentage distribution of degenerative imaging findings by sex (% in parenthesis)

Table 4: Distribution of degenerative image findings by disc level

Spine level	Degenerative imaging findings						
	DD	MODC	DB	DH	CST	NRCOMP	Total
L1/L2	24 (14.5)	3 (1.8)	1 (0.6)	3 (1.8)	1 (0.6)	5 (3)	37 (4)
L2/L3	43 (26.11)	7 (4.2)	4 (2.4)	13 (7.9)	2 (1.2)	16 (9.7)	85 (9)
L3/L4	57 (34.5)	9 (5.5)	15 (9.1)	29 (17.6)	14 (8.5)	38 (23)	162 (17)
L4/L5	109 (66.1)	22 (13.3)	38 (23)	78 (47.3)	41 (24.8)	107 (64.8)	395 (42)
L5/S1	87 (52.7)	14 (8.5)	26 (15.8)	51 (30.9)	15 (9.1)	71 (43)	264 (28)

Percentage distribution of degenerative imaging findings by disc level (*n*=165, at each disc level and for each degenerative imaging finding) (percentage in parenthesis).
DD: Disc degeneration; MODC: Modic change, DB: Disc bulge, DH: Disc herniation, CST: Canal stenosis, NRCOMP: Nerve root compression

subjected to heavy mechanical stress, it is a common area affected by degenerative changes this could partly explain such observation in this study group. The mean age of this study group is 50 ± 12.5 years, could be another explanation, as degenerative changes are common in individuals >40 years of age and its prevalence increases progressively to over 90% by 50–55 years of age.

Disc desiccation was the most frequent finding observed in 137 (83%) patients in this study.

The prevalence was observed to increase with age (60–80 years of age was 100%, whereby in 40–59 and 18–39 years of age were 89% and 43%, respectively). The difference observed between the age groups was significant (P = 0.000) and compares well to the findings of other previous studies. [10] The prevalence of disc degeneration to young individuals (18–39 years) could probably be explained as a result of a genetic predisposition; though, other factors such as repeated traumatic injuries and physical loading history can play a role in causing disc degeneration.[10] The difference in prevalence among young and aged individual could be contributed by the aging process. Disc degeneration was slightly more frequent among males 67 (85.9%) as compared to females 70 (80.5%), though the variation observed was not statistically significant.

Table 5: Type of disc herniation

Disc level	Type of disc herniation		
	Protrusion	Extrusion	Total
L1/L2	3 (1.72)	0 (0.00)	3 (1.69)
L2/L3	13 (7.47)	0 (0.00)	13 (7.34)
L3/L4	30 (17.24)	0 (0.00)	30 (16.95)
L4/L5	78 (44.83)	1 (33.33)	79 (44.63)
L5/S1	50 (28.74)	2 (66.67)	52 (29.38)
Total	174 (100)	3 (100)	177 (100)

Percentage distribution of type of disc herniation (*n*=177: Total number of herniated discs, percentage in parenthesis)

This is similar to the findings reported by Takarad *et al.*[15] The proportion of degenerated disc (reduction in disc signal intensity) progressively increases the lower the spine level, and that most common spine levels were L4/L5 and L5/S18, 23, and 26, is similar to what was observed in this study. At L1/L2 level, 85% of the discs had normal signal intensity, which then progressively decreased to 47% at L4/L5 level, this finding is similar to the previous report by Ong *et al.*[12]

The observation that disc degeneration was not associated with LBP is similar to the findings from the previous report by Filiz *et al.*; however, Cheung *et al.*[13] reported a significant association of lumbar disc degeneration on MRI with back pain.

The prevalence of Modic changes (28%) was higher compared to 23% found by Kuisma *et al.*,[1] and lower than the prevalence of 43% found by Jensen *et al.*[19]

Modic changes in this study increased with age, 6.7%, 31.6%, and 37.8% in the age group of 18–39 years, 40–59 years, and 60–80 years, respectively, and this finding was statistically significant ($P = 0.011$), and this is similar to the findings by Kuisma *et al.*[1] This variation can be due to normal aging process in older individuals. In young individuals, Modic changes are not uncommon, this was observed by Takatalo *et al.*[14] and Filiz *et al.*[4] to be 1.4% and 3.7%, respectively, in patients <30 years. The slight higher prevalence of 6.7% was observed in 18–39 years age group in this study; this could be due to the inclusion of patient with 31–39 years in this age group. Type 2 Modic changes were more common than Type 1 with the prevalence of 22–6%, respectively ($P = 0.022$), this is similar to what was found by Kuisma *et al.*[1]

In this study, it was observed that Modic changes progressively increased the lower the spine level, and the most common location was L4/L5 and L5/S1. This observation is consistent with previous studies by Kuisma *et al.*[1] and Toyone *et al.* (1994).[20].

Modic changes are associated with LBP, but may be present in individuals without LBP. In this study, Modic changes were more common in patients with LBP with radiculopathy as compared to those with LBP only (33% vs. 12%, $P = 0.000$). This can be due to the reason that majority (80%) of patients in this study had LBP with radiculopathy compared to only 20% with LBP only. Disc displacement is also a common finding in LS degenerative disease. The displaced disc can be just a simple bulge or herniation; herniated discs can be protrusion, extrusion or sequestration. In this study, disc herniations were more common than bulges (63%–39% respectively), and this is different from the findings reported by Filiz *et al.*[4] and Ong *et al.*[12] This difference could be due to young study population (individuals <30 years) included in these studies. The prevalence of disc herniation is similar to the findings reported by Modic *et al.*,[21] but lower than what was reported by Shobeir *et al.*[16] and Siddiqui *et al.*[22]

For herniated discs, majority (98%) of types of herniation were protrusion, and only 2% discs were extrusion. In this study, no disc sequestration was seen. Disc bulges were more common among young individuals aged 18–39 years (40%) as compared to individuals aged 60–80 years (32%), unlike disc herniation which was higher among older individuals. Though these findings were not statistically significant ($P > 0.05$). In this study, no significant difference in sex was found in the prevalence of disc bulges and herniations.

Various studies have reported that disc herniation is common at L4/L5 and L5/S1 and the frequency at these levels is ranging from 30% to over 90%.This was also

Table 6: Location of disc herniation

Disc level	Location of disc herniation			
	Posterolateral	Postcentral	Foraminal	Total
L1/L2	2 (67)	1 (33)	0 (0.00)	3 (100)
L2/L3	10 (77)	3 (23)	0 (0.00)	13 (100)
L3/L4	21 (70)	9 (30)	0 (0.00)	30 (100)
L4/L5	58 (73)	19 (24)	2 (3)	79 (100)
L5/S1	41 (79)	10 (19)	1 (2)	52 (100)
Total	132 (75)	42 (24)	3 (2)	177 (100)

Percentage distribution of the location of herniated (percentage in parenthesis)

Table 7: Percentage distribution of degenerative imaging findings by patient presenting symptoms (% in parenthesis)

Findings	Symptoms		
	LBP with radiculopathy (*n*=132)	LBP only (*n*=33)	*P* value
Disc degeneration	111 (84)	26 (79)	0.468
Modic changes	43 (33)	4 (12)	0.020
Disc bulge	50 (38)	14 (42)	0.632
Disc herniation	100 (76)	4 (12)	0.000
Canal stenosis	50 (38)	0 (0)	0.000
Nerve root compression	118 (89)	9 (27)	0.000

LBP: Low back pain

reflected in this study as 74% of the herniated disc was at L4/L5 and L5/S1, this can be due to the large workload causing stress at these lower lumbar levels of the spine. Disc herniation at L3/L4 and L1/L2 was observed in 17% and 2%, respectively, this trend is similar to previous reports.[10] The most location for disc herniation was posterolateral, seen in 75%, followed by posterocentral and foraminal 24%, 2%, respectively, this finding is similar to the previous report.[10] The intraspinal disc herniation (postcentral and posterolateral) was the most common (98%), and this is similar to the findings seen by Takarad *et al*.[15]

The main presentation of disc herniation is sciatica. In this study, 76% of patients with LBP with radiculopathy had disc herniation as compared to 12% in those with LBP only ($P = 0.000$), this is different from a report published by Modic *et al*.[21] This difference could be due to the short duration of patient's presenting symptoms (<3 weeks) in Modic's study, while in this study most of the patients (88%) had symptoms for >12 weeks.

Both sexes were equally affected. Canal stenosis was frequent at L4/L5 and L5/S1, while none was found at L1/L2 level, these findings are similar to other previous studies.[20,21]

Degenerative spinal stenosis is more common in patients with sciatica than in patients with LBP.[3,21] In this study, the prevalence of canal stenosis among patients with radiculopathy was 38%, and none was found among patients with LBP only ($P = 0.000$). These findings are similar to findings by Shobeir *et al*.[16] The small canal in patients with stenosis causes thecal sac or nerve roots to impinge against the spine bone elements hence causing radiculopathy and activity-dependent pain.

Nerve root compression is most common among sciatic patients,[16,22] and lower among patients with LBP. In this study, prevalence of nerve root compression was 77%, and it increased with age being 56.7% and 89.2% in 18–39 and 60–80 years of age, respectively ($P = 0.002$). Males were slightly more affected than females, prevalence being 80.8% and 73.6%, respectively, though the results were not statistically significant.

Shobeir *et al*. 28-reported nerve root compression to be more frequent at level L5/S1, which is different from this study in which L4/L5 was the common site. However, only 3% of patients had nerve root compression at L1/L2 level.

CONCLUSION

In total 165 studied cases, 94% had lumbar degenerative diseases on imaging findings. Disc desiccation was the most frequent finding followed by nerve root compression. The least finding was Modic changes, whereby Type II was more common than Type I. Disc protrusion was the most common type of herniation and was commonly located posterolaterally.

Prevalence of degenerative findings was increasing with age ($P < 0.05$), being more common among males than females, though the difference was not statistically significant ($P > 0.05$). Findings were more frequent at lower lumbar levels (L4/L5 and L5/S1). Canal stenosis, disc herniation, and nerve root compression were common in patients who presented with LBP with radiculopathy. These radiological findings should receive more emphasis during the interpretation of MRI of patients who present with radiculopathy, especially when their symptoms have become chronic.

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