RESEARCH ARTICLE

Pattern of lumbar disc degeneration in young adults with low back pain on 3T magnetic resonance imaging machine

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Abstract

Objective: To determine the frequency and patterns of lumbar disc degeneration in young adults with low back pain.

Method: The descriptive, cross-sectional study was conducted at the Armed Forces Institute of Radiology and Imaging, Rawalpindi, Pakistan, from August 16, 2023, to February 15, 2024, and comprised patients of either gender aged 18-35 years who presented with low back pain. The participants were subjected to examination using 3.0T magnetic resonance imaging machine. Lumbar disc degeneration was noted and its patterns were assessed. Lumbar disc degeneration was graded using Pfirmann grading. Data was analysed using SPSS 25.

Results: Of the 146 patients with mean age 25.6±2.98 years, 103(70.5%) were males and 43(29.5%) were females. Lumbar disc degeneration was present in 85(58.2%) patients, and multilevel involvement was seen in 45(30.8%). The most common involvement was of L3-L4 12(8.2%), followed by L4-L5 11(7.5%). The most common lumbar disc degeneration grade was grade III 39(26.7%), followed by grade IV 25(17.1%).

Conclusion: In more than half of the young adults with low back pain, lumbar disc degeneration was present because of either single or multiple level of vertebrae involvement.

Key Words: Lumbar disc degeneration, Young adults, Low back pain.

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Introduction

Worldwide, intervertebral disc degeneration of the lumbar spine is a prevalent symptom that impacts all populations.[1] These degenerative alterations lead to a number of pathological and musculoskeletal disorders.[2] One of the main reasons for degenerative changes in the lumbar spine is believed to be the constant aging process of humans.[3] These degenerative alterations mostly affect an intervertebral disc that has nearby weakened spine structures. These compromises may be primarily caused by the ageing process linked to specific pathophysiological diseases.[4] While most cases of lumbar spine degenerative disease are asymptomatic, most individuals with these disorders may exhibit symptoms. Individuals with degenerative disease symptoms may exhibit lower back pain (LBP) or radiculopathy discomfort, sometimes known as sciatica. The pressure compression of the nerve root caused by disc bulging, disc herniation, and the release of pain-stimulating biochemicals is the most likely source of this discomfort.[5]

LBP and lumbar disc degeneration (LDD) have a complicated aetiology. Disc degeneration may result in lower functional status and LBP, which could have a negative socioeconomic impact and raise medical expenses.[6] As a matter of fact, LBP is among the most prevalent conditions that prompt someone to seek a general practitioner's medical advice.[7] LBP affects almost seven out of 10 people at some point in their lives. Among the other illnesses assessed in a 2010 Global Burden of Disease research, LDD ranked the highest in terms of disability.[8]

It has been noted recently that younger people are more likely to suffer from LBP issues.[9] Radiological techniques, such as magnetic resonance imaging (MRI), are favoured for more precise and reliable diagnosis of certain disorders. MRI is a very accurate, sensitive and non-invasive technique for assessing disc degeneration and the pathophysiological alterations it is linked with.[10]

It is challenging to come to a definitive understanding of LDD due to the relative lack of data and the observed variances in the reported evidence. Apart from comprehending the anatomical alterations associated with LDD, it is essential to comprehend the pattern of LDD and the combinations of lumbar levels involved. The current study was planned to determine the frequency and patterns of LDD in young adults presenting with LBP.

Patients and Methods

The descriptive, cross-sectional study was conducted at the Armed Forces Institute of Radiology and Imaging,

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Table-1: Pfirmann classification of lumbar disc degeneration (LDD).

Grade	Structure	Distinction Of Annulus And Nucleus	Signal Intensity	Height Of Intervertebral Disc
I	Homogenous, bright white	Clear	Hyperintense, isointense to cerebrospinal fluid	Normal
II	Inhomogenous with or without horizontal bands	Clear	Hyperintense, isointense to cerebrospinal fluid	Normal
III	Inhomogenous grey	Unclear	Intermediate	Normal to slightly decreased
IV	Inhomogenous, grey to black	Lost	Intermediate to hypointense	Normal to moderately decreased
V	Inhomogenous black	Lost	Hypointense	Collapsed disc space

Figure-1: T2-weighted sagittal and axial images showing circumferential disc bulge causing indentation of epidural fat, narrowing of bilateral lateral recesses and neural foramina with resultant compression of bilateral transiting nerve roots and impingement of bilateral exiting nerve roots at LV5-SV1 level.

Rawalpindi, Pakistan, from August 16, 2023, to February 15, 2024. After approval from the institutional ethics review committee, the sample size was calculated using the World Health Organisation (WHO) calculator[11] with 95% confidence interval (CI), 8% margin of error, and expected percentage of LDD in young adults 58.6%.[12] The sample was raised using non-probability consecutive sampling technique. Those included were patients of wither gender aged 18-35 years who reported with LBP, which was defined as continuous, localised pain lasting >2 weeks. Those excluded were patients with congenital deformities, infection and previous surgery in the lumbar spine.

After taking written informed consent from the patients, detailed demographic and clinical history was noted down on a predesigned proforma, and they were subjected to relevant physical examination. Pain was assessed using the visual analogue scale (VAS).[13] All patients were then subjected to a 3.0T MRI with integrated spine coil (Magnetom Verio, A Tim System; Siemens, Erlangen, Germany). After the subjects were lying supine, the following scans were carried out: sagittal T1 turbo spin echo (TSE) imaging from T12 to the sacrum (recovery time: 670ms; echo time: 12ms, slice thickness: 4mm); sagittal T2 TSE imaging from T12 to the sacrum (recovery time: 3,000-3,600ms; echo time: 87-114ms, slice thickness: 4mm); and axial T2 TSE imaging from L1 to S1 (recovery time: 3,000-3,600ms; echo time: 87-114ms, slice thickness: 4mm). MRI images of the L1/2 to L5/S1 were analysed for the spine structural appearance, intervertebral disc structural appearance, signal intensity and any pathology, like herniation, annular fissure and nuclear degeneration. Two experienced radiologists assessed all the MRIs. All cases were classified according to the nomenclature version 2.014. The lumbar discs were defined as normal when they were morphologically normal, without the consideration of the clinical context and not inclusive of degenerative, developmental or adaptive changes that could, in some contexts (e.g., normal aging, scoliosis, spondylolisthesis), be considered clinically normal. LDD included any or all of the following: desiccation, fibrosis, narrowing of the disc space, diffused

Figure-2: T2-wighted sagittal and axial images showing circumferential disc bulge causing indentation of thecal sac, narrowing of bilateral lateral recesses and left neural foramina with resultant compression of bilateral transiting and left exiting nerve roots at LV4-5 level.

bulging of the annulus beyond the disc space, fissuring (i.e., annular fissures), mucinous degeneration of the annulus, intradiscal gas, osteophytes of the vertebral apophyses, defects, inflammatory changes, and sclerosis of the end plates. Lumbar disc herniation was defined as a localised or focal displacement of the disc material beyond the limits of the intervertebral disc space. The disc material might be nucleus, cartilage, fragmented apophyseal bone, annular tissue, or any combination thereof.[14] All the cases were graded according to the degree of degeneration of the disc into 5 grades on MRI using the Pfirmann grading system[15] (Table 1).

At each lumbar level (L1-L2, L2-L3, L3-L4, L4-L5 and L5-S1), the prevalence of degenerative disc grading was evaluated. Non-LDD states were described as discs with a Pfirrmann grade of I or II. Substantial LDD states were identified as discs categorised as Pfirrmann grades III, IV or V. Additionally, the number of LDD lumbar levels was evaluated. As a result, the patients were categorised as LDDs with one, two, three, four or five levels. One level involvement was labelled as single level LDD, whereas the involvement of two or more levels was labelled as multilevel LDD. Analysis was also done on the prevalence of the various LDD levels. Patterns of degeneration, such as disc bulge (Figures 1-2), herniation of disc, stenosis of the canal and nerve root compression were assessed.

Data was analysed using SPSS 25. Quantitative data was presented as mean ± standard deviation. Qualitative data was presented as frequencies and percentages. Association between LDD grade and pattern was assessed using chi-square test. P≤0.05 was considered significant.

Results

Of the 146 patients with mean age 25.6±2.98 years, 103(70.5%) were males and 43(29.5%) were females. Mean VAS score was 6.5±1.02, and the mean LBP duration was 3.1±1.22 months.

LDD was present in 85(58.2%) patients. Single level vertebral involvement was seen in 40(27.4%) patients and multilevel involvement in 45(30.8%). The most common LDD level was L3-L4 12(8.2%), followed by L4-L5 11(7.5%). The most common LDD grade was grade III 39(26.7%), followed by grade IV 25(17.1%). The most common associated pathologies with LDD was disc bulge 41(28.1%) (Table 2).

Table-2: Demographic and clinical variables (n=146).

Variable	Frequency (percentage)
Gender:	
Male	103 (70.5%)
Female	43 (29.5%)
Lumbar disc degeneration:	
Yes	85 (58.2%)
No	61 (41.8%)
Type of level involvement by LDD	
Single level involvement	40 (27.4%)

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Multiple level involvement	45 (30.8%)
Type of multilevel involvement in LDD	
Two levels involvement	31 (21.2%)
Three levels involvement	11 (7.5%)
Four levels involvement	2 (1.4%)
Five levels involvement	1 (0.7%)
Level of LDD:	
No degeneration	61 (41.8%)
L1-L2	8 (5.5%)
L2-L3	6 (4.1%)
L3-L4	12 (8.2%)
L4-L5	11 (7.5%)
L5-S1	3 (2.1%)
Pfirmann grading of LDD	
Grade I	8 (5.5%)
Grade II	8 (5.5%)
Grade III	39 (26.7%)
Grade IV	25 (17.1%)
Grade V	5 (3.4%)
Associated pathologies with LDD:	
Disc herniation	18 (12.3%)
Disc bulge	41 (28.1%)
Nerve root compression	17 (11.6%)
Canal stenosis	9 (6.2%)

LDD: Lumbar disc degeneration.

Table-3: Lumbar disc degeneration (LDD) and associated pathologies with respect to Pfirmann grading (n=85).

Pfirmann grading	Disc herniation	Disc bulge	Nerve root compression	Canal stenosis	p-value
Grade I	1 (0.7%)	5 (3.4%)	2 (1.4%)	0 (0%)	0.828
Grade II	1 (0.7%)	3 (2.1%)	3 (2.1%)	1 (0.7%)	
Grade III	11 (7.5%)	18 (12.3%)	5 (3.4%)	5 (3.4%)	
Grade IV	5 (3.4%)	12 (8.2%)	6 (4.1%)	2 (1.4%)	
Grade V	0 (0%)	3 (2.1%)	1 (0.7%)	1 (0.7%)	

Grade I vs II: p=0.601; Grade I vs III: p=0.483; Grade I vs IV: p=0.773; Grade I vs V: p=0.494; Grade II vs III: p=0.267; Grade II vs IV: p=0.485; Grade II vs V: p=0.827; Grade III vs IV: p=0.857; Grade III vs V: p=0.299; Grade IV vs V: p=0.444.

The associated pathologies has no significant association with LDD grade (Table 3).

Discussion

The current study revealed that in young LBP patients, LDD was present in 58.2%. There has been evidence of a slight to high correlation between low back discomfort and LDD in previous studies.[16] It is challenging to come to a definitive understanding of LDD due to the relative lack of data and the observed variances in the reported evidence.[17] MRI frequently reveals intervertebral LDD, and is the gold standard investigation for detecting it.[18] MRI has proven to be able to properly assess LDD and provide the data required to consistently and accurately categorise LDD severity.[19]

Chadha et al. reported that LDD was present in 56% young adults in their sample.[20] Berg et al. reported it to be 58.6%[12], and Brinjikji et al. reported >50%.[21] These findings support the current findings.

The higher frequency of males in the current study may be attributed to the increased mechanical stress and physical injuries sustained by males compared to the females.

In the current study, majority of the young patients had multilevel involvement of the lumbar vertebra (30.8%). Chadha et al. also reported that majority of the young adults with LDD had multilevel involvement.[20] Berg et al. revealed that the involvement was mainly at single level (59.6%).[12]

The current study revealed that most of the young individuals had involvement of L3-L4 and L4-L5 vertebra. Chadha et al. reported L4-L5 (38%) and L5-S1 (30%)[20], while Berg et al. reported the involvement of L5-S1 (44%) and L4-L5 (35%).[12] These differences may be because of the racial and genetic differences in the patients.

Among the associated pathologies with LDD, the commonest were disc bulge (28.1%) and disc herniation (12.3%) in the current study. Brinjikji et al. also reported disc bulge (43%) and disc herniation (40%) in their sample[21]. Another study also revealed that among the symptomatic patients with LDD, majority had disc bulge, followed by disc herniation.[22] These findings are consistent with the current results.

The current study has certain limitations. Firstly, the study was carried out at a single centre and the sample size was relatively small. As such, the results cannot be generalised. Secondly, only young adults were assessed who had lower back pain, and the findings in asymptomatic individuals were not assessed.

Conclusion

Among the young adults with: BP assessed, LDD was present in 58.2%. Majority of the patients had multilevel involvement, and LDD was mainly of Grade III. Among the LDD associated pathologies, the commonest was disc bulge.

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