International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Magnetic Resonance Imaging Findings in Patients with Low Backache Due to Lumbar Degenerative Disease and It's Correlation with Modified Oswestry Disability Index

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Abstract: ***Background**: Low backache is a common disability worldwide, often caused by lumbar degenerative disease. MRI is used to evaluate spinal degenerative changes, but the Oswestry Disability Index (ODI) quantifies functional impairment. Understanding MRI findings and ODI correlations is crucial for treatment. **Objective**: To analyze MRI findings in low back pain caused by lumbar degenerative disease and determine the correlation between MRI changes and the severity of self-assessed modified Oswestry Disability Index in patients. The assessment of this correlation helps clinicians make early management decisions for patients. **Methods**: This was a cross-sectional study conducted at Department of Radiodiagnosis, BRD Medical College, Gorakhpur, involving 300 patients with low back ache complaints for 12 months, with written informed consent taken. Patients with low backache complaints were referred to the radiology department for a lumbosacral spine MRI from the neurology department. MRI scans of the lumbar spine were performed using a 1.5T Siemens machine. **Results**: A study of 300 patients found disc bulge prevalent in the 4th-6th decades, with a higher incidence in females. Degenerative disc changes were most common in individuals aged 40-60 years, with a higher incidence in females. Central disc bulging was the most common type among the disc Herniation, with L4-L5 level being the most affected. Annular fissures and tears were predominantly found at L4-L5 intervertebral disc level. 51 patients had severe findings, including severe spinal canal stenosis, facet joint arthropathy, and neural foraminal stenosis, primarily in the 30-50 range. **Conclusion**: The study reveals that MRI findings in patients with low backache due to lumbar degenerative disease do not always correlate strongly with functional disability, emphasizing the need for clinical evaluation and patient-reported disability for comprehensive assessment and management.*

Keywords: Low backache, Oswestry Disability Index, Long-Term Disability, Magnetic resonance imaging (MRI)

1. Introduction

Low backache (LBA) affects 60-80% of people worldwide, with a significant proportion progressing to chronic pain and disability. Lumbar degenerative diseases (LDD) are the primary cause, including lumbar disc herniation, spinal canal stenosis, and degenerative disc disease. Magnetic Resonance Imaging (MRI) is a crucial diagnostic tool for LDD evaluation. Low back pain is a global concern due to degenerative spinal illnesses, particularly in industrialized countries, affecting all age demographics, particularly those aged 40 and beyond. [1-3]

The Modified Oswestry Disability Index (ODI) is a widely used standardized tool for assessing the impact of Long-Term Disability (LDD) on patient functioning, indicating higher scores indicate more functional disability. [4,5] Studies show that 60% to 80% of the general public experiences low back pain at least once in their lifetime. Spine degenerative changes, affecting intervertebral discs, vertebral periosteum, facet joints, and spinal ligaments, are normal physiological phenomena. The lumbar area is particularly susceptible due to mechanical and rotational stresses. MRI evaluations reveal indicators like disc desiccation, reduced disc height, diffuse disk bulging, disc prolapse, fissuring, endplate changes, and osteophyte development. [6,7]

Magnetic resonance imaging (MRI) is a crucial diagnostic tool for detecting degenerative changes in the lumbosacral spine, including T2 signal alteration, reduction of disc spaces, annular tears, gas collections, calcification, hypertrophy of ligamentum flavum, modified marrow signals, marginal osteophytes, disc herniation, and spinal canal stenosis. It offers a comprehensive view of disc diseases and their impact on the spinal canal, nerve roots, neural foramina, spinal cord, and surrounding tissues. [7-10]

This study examines MRI characteristics in patients with low back pain due to lumbar degeneration and correlates them with the Modified Oswestry Disability Index score to determine if abnormalities reflect disability. The results may refine diagnostic and therapeutic approaches, emphasizing the need for a multidisciplinary approach in managing lumbar degenerative diseases. The study aims to classify lumbar degenerative changes using MRI parameters and establish a correlation between MRI-detected changes and MODI scores.

2. Methods

This was a cross-sectional study conducted at Department of Radiodiagnosis, BRD Medical College, Gorakhpur, involving 300 patients with low back ache complaints for 12 months, with written informed consent taken.

Patients with low backache complaints were referred to the radiology department for a lumbosacral spine MRI from the neurology department.

The study excluded individuals with low back pain due to infective or neoplastic etiology, history of trauma or operative intervention, or uncooperative, severe claustrophobia.

Marginal osteophytes, disc bulge, disc herniation, annulus fissure/tear, modic endplate changes, spinal canal stenosis, neural foramina stenosis, and facet joint arthropathy are common conditions.

Oswestry Low Back Pain Disability Questionnaire tool is used to measure patient's permanent functional disability and considered as the 'gold standard' of low back functional outcome tools Score: /50 x 100 = __% points

Scoring: For each section total possible score is 5: if the first statement is marked then the section score = 0, if last statement is marked it = 5.

If all the ten sections are completed score is calculated as follows: Example: 16 (total scored) 50 (total possible, score) x 100 = 32% If one section is missed or not applicable the score is calculated: 16 (total scored) 45 (total possible score) x 100 = 35.5% Minimum Detectable Change (90% confidence): 10%points (Change of less than this amount may be attributed to error in the measurement.) The study focuses on patients with chronic low backache who underwent an MRI L-S spine examination. The MRI findings will be graded based on severity, and patients will be asked to complete an OBI questionnaire. The questionnaire contains six statements related to impairments and abilities, with scores ranging from 0 to 5. Patients will choose the statement that best describes their status, and if the limitation falls between two levels, a higher point value will be selected. The total scores range from 0 to 50, with a percentage disability calculated based on the total possible points. The relationship between MRI findings and total scores will be assessed to assess the extent of disability. The study aims to provide valuable insights into the impact of MRI on patients' daily lives.

The study used Microsoft Excel, SPSS 16.0 for data analysis, with Chi square test used to identify significant group differences. A p value less than 0.05 was considered statistically significant at 95% confidence range.

3. Results

Total 300 patients, females 174 (58.0%) and 126 (42.0%) males, found disc bulge to be prevalent in 4th-6th decades, with a significant predilection for females. (Table 1)

Table 1: Distribution of patients based on the age and Gender

Age Groups (in yrs)	Female		Male		Total	
	No.	%	No.	%	No.	%
30-40	58	33.33	47	37.30	105	35.00
41-60	79	45.40	51	40.48	130	43.33
61-80	37	21.26	28	22.22	65	21.67
Total	174	58.00	126	42.00	300	100.0

Diffuse disc bulges 215 (71.66%%) are the most commonly identified type and among disc herniation 85(28.33%), subarticular (paracentral) and central type dominates the pattern. (Table 2)

Table 2: Distribution of Diffuse Disc bulge vs Disc herniation

	No. of Patients	Percentage (%)
Diffuse disc bulge	215	71.66%
Disc herniation	85	28.33%

Total exceeds 300 due to multiple levels per patient (e.g., L4-L5 and L5-S1). L4-L5 is the most affected (58%), followed by L5-S1 (42%), aligning with biomechanical stress patterns. Total 71 patients (23.66%), with L4-L5 (13.6%) most common, consistent with stress distribution. (Table 3)

Table 3: Distribution According to Spinal Level and Ligamentum Flavum Hypertrophy

Spinal Level	No. of Patients	Percentage (%)
L1-L2	8	2.66%
L2-L3	17	5.66%
L3-L4	53	17.66%
L4-L5	174	58.0%
L5-S1	126	42.0%
Ligamentum Flavum Hypertrophy		
L1-L2	2	0.66%
L2-L3	4	1.33%
L3-L4	8	2.66%
L4-L5	41	13.66%
L5-S1	16	5.33%
Total	71	23.66%

Total: Out of 300 patients, 215 patient were having diffuse disc bulge while 85 patients were having disc herniation. Out of 85 patients having disc hernaition, Subarticular (Paracentral) and central Disc herniation dominates (89.4%) being most common type. Total occurrences: 85(not all 300 patients have herniation), with Protrusion being the most common (58.58%).85 patients (28.33%) have herniation (P, E, M, S). (Table 4)

Table 4: Distribution According to Type of Disc Herniation Based on axial location

Type of Disc Bulge	No. of Patients	Percentage (%)
Central (C)	31	36.5%
Subarticular(S)/ Paracentral	45	52.9%
Foraminal (F)	7	8.2%
Extraforaminal (E)	2	2.4%
Total	85	28.33%
Type of Disc Herniation		
Protrusion (P)	43	50.58%
Extrusion (E)	18	21.17%
Migration (M)	20	23.52%
Sequestration (S)	4	1.33%
Herniation Status		
Present	85	28.33%
Absent	215	71.66%

Total 108 patients (36%), with Type II (23%) most common, reflecting Modic change prevalence. (Table 5)

Table 5: Distribution of Degenerative Endplate Changes

Type of Change	No. of Patients	Percentage (%)
Type I	18	6.0%
Type II	69	23.0%
Type III	21	7.0%
Total	108	36.0%

The study involved 227 patients (75.66%), with Grade 1 being the most common and Grade 3 correlated with higher Oswestry scores. Grade I was the most common, while Grade III was rare. Grade 1 was the most frequent, and Grade 3 was rare but present, indicating severe Oswestry scores. (Table 6)

Table 6: Distribution of Spinal Canal Stenosis, Neural Foraminal Stenosis and Facetal Arthropathy

Spinal Canal Stenosis (Grade)	No. of Patients	Percentage (%)
Grade 1	121	40.33%
Grade 2	65	21.66%
Grade 3	41	13.67%
Total	227	75.66%
Neural Foraminal Stenosis (Grade)		
Grade I	167	55.66%
Grade II	45	15.0%
Grade III	22	7.33%
Total	234	78.0%
Facetal Arthropathy		
Grade 1	103	34.3%
Grade 2	42	14.0%
Grade 3	21	7.0%
Total	166	55.33%

The study identifies 51 patients with severe findings, including severe spinal canal stenosis, facet joint arthropathy, and neural foraminal stenosis, primarily in the 30-50 range of Modified Oswestry Score, with 40 patients exhibiting Grade 3 severe spinal canal stenosis, and a maximum of 127 having a score between 10-20. (Table 7)

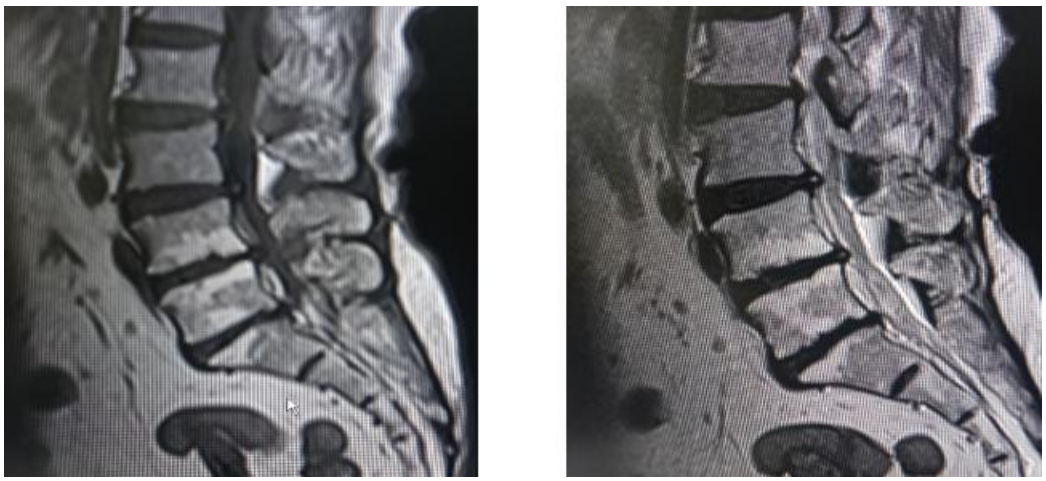
Table 7: Distribution According to Modified Oswestry Score

Score Range	No. of Patients	Percentage (%)
0-10	84	28.33
10-20	127	42.67
20-30	38	12.67
30-40	37	12.33
40-50	14	4.67
Total	300	100.00

Disc herniation with inferior disc migration

T2WI Saggital section: Disc Herniation with inferior disc migration at the L4-L5 level, the disc is inferiorily migrating upto upper 2/3rd of posterior cortical margin of L5 vertebra.

Type 2 Modic Degenerative end plate changes

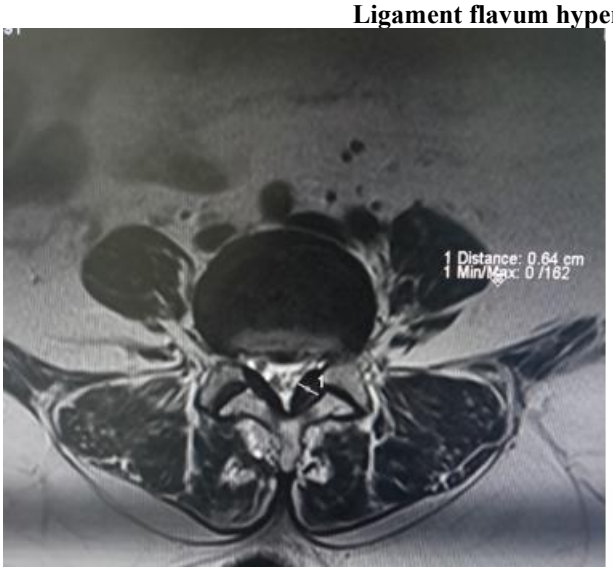


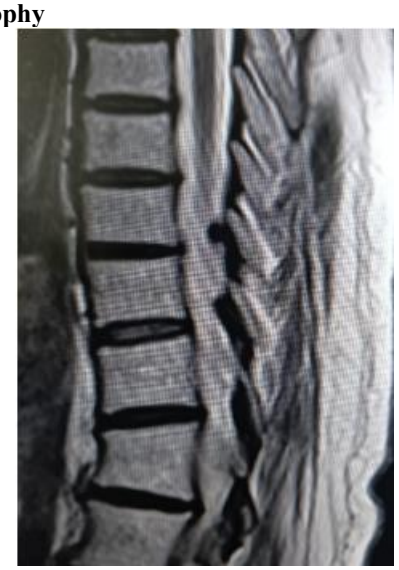
Type 2 Modic Degenerative end plate changes: T2 & T1 Hyperintense signal changes seen at the inferior and superior end plates of L4 & L5 vertebrae respectively

Schmorl's Node

T2W Saggital section: Schmorl's node (Intervertebral disc herniation) at superior end plates of L2, L3, L4 Vertebrae along with degenerative end plate changes at multiple levels and Disc bulge at L4-L5 vertebral level

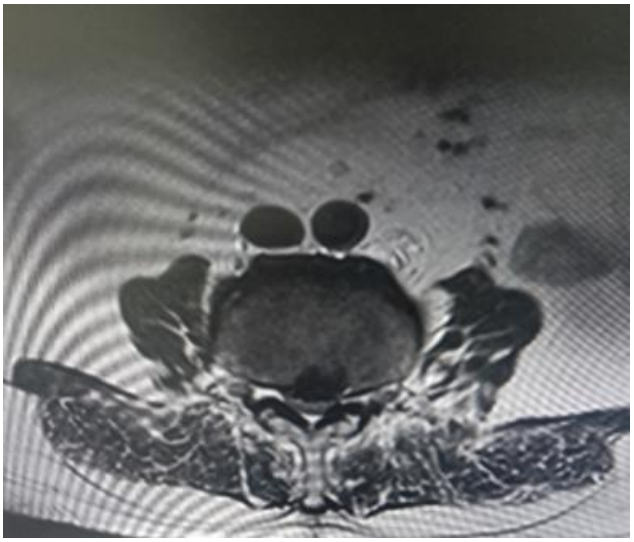
Ligament flavum hypertrophy





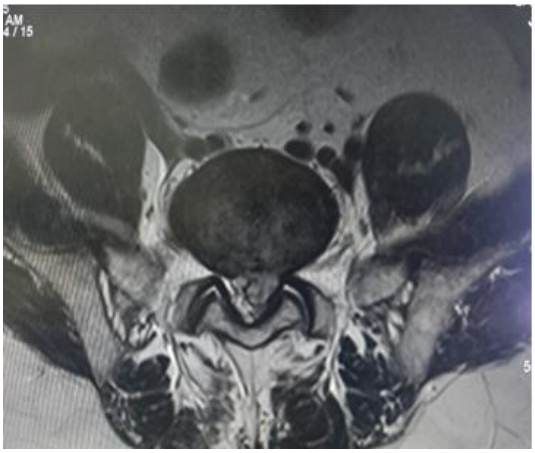
T2W Saggital and axial section images : showing Ligamentum flavum hypertrophy resulting into Spinal canal stenosis

Central protrusion



T2W axial section images: Showing Disc herniation in the form of Central protrusion resulting into Spinal canal stenosis and impingement of Bilateral traversing nerve roots

Disc extrusion



T2W Saggital and axial images: Showing Disc herniation with slightly left central Extrusion at L5-S1 impinging the left traversing nerve roots

T2W Saggital section image: Showing Disc protrusion at L5-S1 level with Superior disc migration, along with Degenerative end plate changes in the form of T2 Hyperintense signal at L5-S1

Disc herniation with superior disc migration

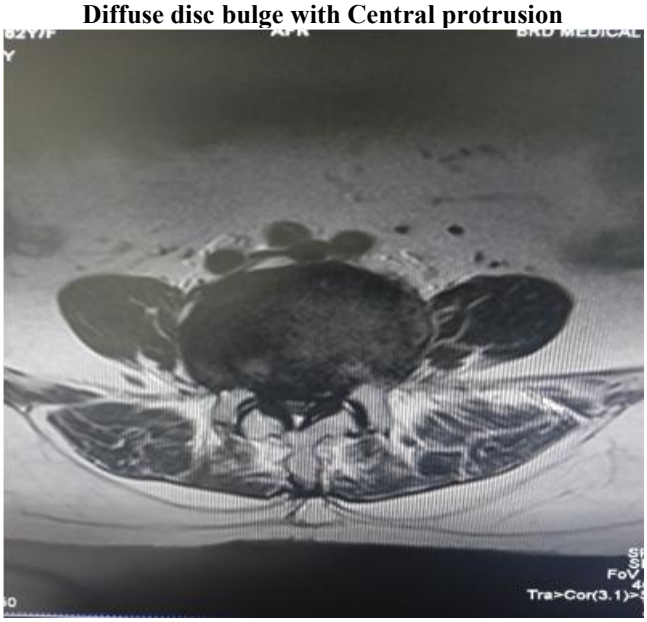
Diffuse Disc bulge with paracentral protrusion

T2W axial section image: Showing Diffuse Disc bulge with Left paracentral protrusion causing severe narrowing of left lateral recess and Impingement of Left traversing nerve roots at L5-S1 vertebral disc level

Subarticular Disc herniation

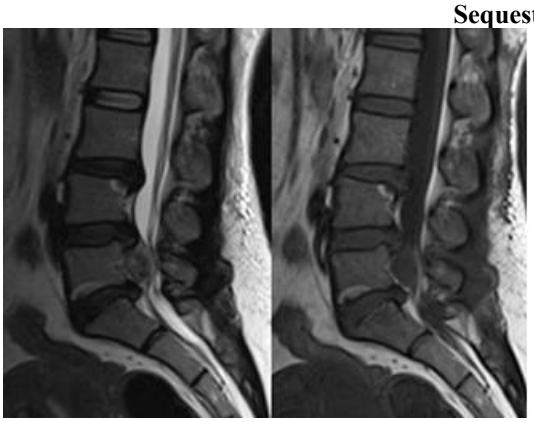
T2W axial image: Showing left sided subarticular disc bulge causing severe narrowing of left lateral recess and obliteration of left sided neural foramina along with partial compression of left sided Exiting nerve roots

Diffuse disc bulge with Central protrusion



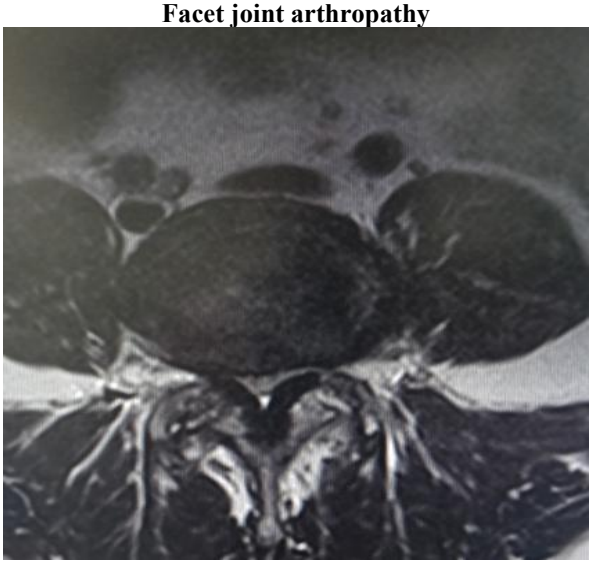
T2W axial section image: Showing Diffuse Disc bulge with Central protrusion resulting into severe narrowing of Bilateral lateral recess and total obliteration of bilateral neural foramina, impinging and compressing bilateral traversing and exiting nerve roots along with spinal canal stenosis

Sequestered Disc



T2W and T1W Saggital section images : Showing extradural mass like lesion which is T2 Hyperintense and T1 isointense relative to the Disc at the level of L5 vertebra in the anterior epidural space .On T1 + Post Contrast study, axial and Saggital section images : Shows Peripheral rim enhancement of the sequestered disc material

Facet joint arthropathy



T2W axial section images : Showing Reduced bilateral facet joint spaces (Right>Left), marginal osteophytes and joint hypertrophy along with mild fluid signal within resulting into Spinal canal stenosis.

4. Discussion

The study found that MRI is a valuable tool for detecting degenerative changes in the lumbar spine in chronic low backache patients. Common findings included intervertebral disc degeneration, disc bulge, disc herniation, modic endplate changes, facet joint arthropathy, ligamentum flavum hypertrophy, and spinal canal stenosis.

Studies indicate that 60% to 80% of people will experience low back pain at least once in their lives, which can vary in intensity and potentially cause significant disability. Degenerative changes in the spine, including intervertebral discs, vertebral periosteum, facet joints, and spinal ligaments, can contribute to low back pain. The lumbar spine is particularly vulnerable due to heavy mechanical stress. [1-3]

Spinal MRI can identify degeneration in discs through various imaging findings, such as diffuse disc bulging, disc herniation, annular fissures, end plate changes, facet joint arthropathy, ligamentum flavum tightening, and spinal canal narrowing. These findings aid in diagnosing and treating various conditions. Intervertebral discs also show changes, such as loss of T2 signal, reduced disc space, annular fissures, air pockets, calcification, ligamentum flavum thickening, altered bone marrow signals, and disc herniation.[7]

Standard X-rays are commonly used to detect bony changes in the lumbosacral spine in low back pain patients, but they lack a comprehensive view of soft tissue structures.

MRI is the preferred diagnostic method for low back pain due to its multi-planar imaging capabilities, which provide detailed views of intervertebral discs, nerves, ligaments, paraspinal muscles, epidural fat, cerebrospinal fluid, and bone marrow. It is the most sensitive tool for diagnosing brain and spinal conditions, including disc problems and their effects on the spinal canal. [8,9] The Oswestry Disability Questionnaire is a crucial tool for assessing the impact of low back pain on daily functioning.[10] Its modified version can improve MRI diagnostic value in cases of lumbar degenerative diseases, aiding orthopedic surgeons in early intervention and management.

Miller JA et al.'s study on lumbar intervertebral discs revealed that male discs show more degeneration than female ones, particularly in the second, fifth, sixth, and seventh decades. Modic MT et al.'s study found a correlation between clinical symptoms and MRI findings related to herniated nucleus pulposus. Fairbank et al.'s study highlighted the Oswestry Disability Index's importance in assessing functional disability. [2,5]

Disc degeneration is a leading cause of functional incapacity and chronic disability in working individuals, with a higher incidence in females. Studies have shown that disc space narrowing at multiple levels is more strongly linked to low back pain than other radiographic features, and spinal canal narrowing at multiple levels correlates with higher Oswestry disability scores. Additionally, studies have found a significant correlation between Oswestry Disability Index scores and multilevel stenosis in patients with central lumbar spine stenosis. Finally, patients with severe spinal canal stenosis have higher Oswestry disability scores. [3, 4, 8, 9]

The Oswestry Disability Index (ODI), also known as the Oswestry Low Back Pain Disability Questionnaire, is a crucial tool for assessing long-term functional impairment in patients with lower back issues. Its strong correlation with spinal canal stenosis has been established by Fairbank et al. (2000).[10]

The study analyzed MRI characteristics in patients with lumbar degenerative diseases, evaluating outcome variables such as disc bulging, disc herniation, annular tears, degenerative end plate changes, facet joint arthropathy, Ligamentum flavum hypertrophy, and spinal canal and neural foramina stenosis, and examining the influence of age and gender.

The study assessed MRI findings of lumbar degenerative disease in 300 patients and their association with functional disability using the Modified Oswestry Disability Index. The findings revealed a consistent pattern of degenerative changes, primarily affecting the lower lumbar spine, with L4-L5 and L5-S1 levels being the most frequently involved. The data shows diffuse disc bulge in 71.6% of patients, followed by disc herniation in 28.3%, with central and subarticular bulges at L4-L5 and L5-S1 being more common. Disc herniation, often accompanied by annulus tears, suggests a progressive degenerative process. Degenerative endplate changes were more frequent at L5-S1.

The study reveals a significant correlation between spinal canal stenosis severity and higher ODI scores, with patients with Grade III stenosis consistently showing ODI scores exceeding 35, indicating moderate to severe disability. This relationship is less pronounced with neural foraminal stenosis, suggesting central canal narrowing impacts functional impairment more. Facial arthropathy and ligamentum flavum hypertrophy also show a moderate association with disability.

The study found a gender preference for females, but patients over 50 had higher degenerative changes and elevated ODI scores, suggesting progressive and age-dependent degenerative processes, with younger patients reporting minimal disability.

The study by Agarwal et al. investigated the relationship between MRI abnormalities in adult patients with degenerative disc changes. The most common patterns were disc bulging and foraminal stenosis, with foraminal stenosis showing a significant correlation with disability. However, spinal canal stenosis had a poor correlation with the ODI score. The study suggests routine MRIs with ODI, especially in rural populations, for better prediction of clinical disability in degenerative disc patients.[11]

The Chowdhary et al MRI is a non-invasive imaging method that accurately diagnoses lumbar degenerative conditions,

detecting even minor abnormalities. Its modified Oswestry Disability Index is a superior tool for evaluating patients' functional disability.[12]

The study examines the correlation between magnetic resonance imaging (MRI) findings and the modified Oswestry Disability Index (ODI) in patients with low backache due to lumbar degenerative disease. Despite limitations such as cross-sectional design and potential selection bias, the study offers valuable insights into radiological patterns associated with functional disability. Its strength lies in its objective assessment using standardized MRI criteria and a validated disability index. The findings emphasize the importance of correlating imaging results with patient-reported outcomes, rather than solely relying on radiological severity. This could guide personalized management plans and avoid unnecessary interventions in asymptomatic radiological abnormalities.

5. Conclusions

A study involving 300 patients with lumbar degenerative disease found that degenerative changes primarily affect the L4-L5 and L5-S1 vertebral levels. The most common condition was disc bulge, followed by herniation and spinal canal stenosis. A significant correlation was found between the severity of spinal canal stenosis and increased functional disability, as indicated by higher Oswestry Disability Index (ODI) scores, especially in patients with Grade III stenosis. Age-related patterns indicate that older patients experience a greater burden of degeneration and disability, while mild findings in younger patients are linked to minimal impairment. The study highlights the clinical importance of central canal pathology in managing lumbar degenerative disease and the value of MRI in predicting functional outcomes.

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