DEPARTMENT OF HUMAN ANATOMY, SCHOOL OF MEDICINE, COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY

CORRELATION BETWEEN PATTERNS OF MAGNETIC RESONANCE IMAGING FINDINGS AND CLINICAL FEATURES IN PATIENTS WITH LOW BACK PAIN DUE TO LUMBAR DEGENERATIVE DISC DISEASE, ATTENDING TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA 2021.

A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Masters of Science in Human Anatomy.

BY: Dureti Godanna (BSC.)

ADDIS ABABA, ETHIOPIA

SEPTEMBER, 2021

Department of Human Anatomy, School of Medicine, College of Health Sciences, Addis Ababa University

Correlation Between Patterns of Magnetic Resonance Imaging Findings and Clinical Features in Patients with low back pain due to Lumbar Degenerative Disc Disease, attending orthopedics and neurology outpatient clinic in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia 2021.

Principal Advisor:

Professor Mekbeb Afework

Co- advisors

1. **Dr. Biruk Lambisso (Associate Professor and department head of Orthopedics)**
2. **Dr. Eskinder Kebede (Associate Professor)**
3. **Dr. Hailegebriel Degefu**

Addis Ababa, Ethiopia

SEPTEMBER, 2021

DECLARATION

ASSURANCE OF PRINCIPAL INVESTIGATORS

I, the undersigned, declare that this postgraduate thesis is my original work, and has not been presented for a degree in any other university, and that all sources of materials used for the thesis have been duly acknowledged.

1. Name of the student----------signature----------

Date----------

APPROVAL OF THE FIRST ADVISOR

Name of the first advisor----------signature----------

Date----------

APPROVAL OF THE SECOND ADVISOR

Name of the second advisor----------signature----------

Date ----------

APPROVAL OF EXTERNAL EXAMINER

Name: ----------

Signature---------- Date. ----------

ACKNOWLEDGEMENT

My deepest gratitude and heartfelt thanks go to my advisors Prof. Mekbeb Afework, Dr. Biruk Lambisso, Dr.Eskinder Kebede, and Dr. Haielegebriel Degefu for their constructive comments, supervision, and guidance throughout my thesis work. I am also thankful to Addis Ababa University College of Health Science, School of medicine, and the Anatomy department for providing such an opportunity to make this research paper. I would also like to thank the department of orthopedics for their support. My deepest gratitude goes to my friends and families for their unwavering support and encouragement throughout this master's program

ACRONYMS AND ABBREVIATIONS

LDDD-	Lumbar Degenerative Disc Disease
DD-	Disc Degeneration
MRI-	Magnetic Resonance Imaging
LBP-	Low Back Pain
IVD-	Intervertebral disc
LSS-	Lumbar spinal stenosis
NF-	Neural foramen
HIZ-	High-Intensity Zone
NHIS-	National Health Interview Survey
US-	United States
GBD:	Global burden of Disease
ETB:	Ethiopian Birr
SPSS:	Statistical Package for Social science
TASH:	Tikur Anbessa Specialized Hospital

Table of content

List of figures

List of tables

Abstract

Background: Low back pain(LBP) is defined as pain coming from between the lower rib margins and the gluteal folds. It is usually accompanied by pain and neurological symptoms in the lower limbs. Lumbar degenerative disc disease constitutes a group of degenerative pathologic changes that are almost universal with increasing age and are a common cause of mechanical low back pain. There were contradictory reports regarding the correlation of MRI(magnetic resonance imaging) findings with clinical presentations.

Objective: To evaluate the correlation between patterns of MRI findings and clinical features in patients with low back pain due to lumbar degenerative disc disease(LDDD) at Ortho-spine unite, in Tikur Anbessa Specialized Hospital(TASH), Addis Ababa, Ethiopia, from April 1, 2020, to March 30, 2021.

Method: Hospital-based retrospective cross-sectional study was conducted in TASH, with a randomly selected sample of 246 patients from April 1, 2020, to March 30, 2021. Data was collected using Kobo Toolbox version 1.27.3 and exported to SPSS Windows 25 for analysis. Chi-square test, Bivariable, and Multivariable binary logistic regression analysis were applied to evaluate the association of different variables.

Result: Of the total patients, 56.5% had radiculopathy, 6.1% had extremity weakness and 4.5% had bowel and bladder incontinence. Disc herniation was present in 82.9%, disc degeneration in 54.1%, neural foraminal stenosis in 56.6% and spinal canal stenosis in 44.3%. Spinal canal stenosis was significantly associated with age (age 40-59 [AOR=2.19, 95% CI (1.119-4.287)] & age >60 [AOR=3.7, 95% CI (1.753-7.691)] and radiculopathy, [AOR=2.4, CI (1.388-4.072)]. Neural foraminal stenosis was significantly associated with age [age >60, AOR=3.425, 95% CI (1.560-7.519)], radiculopathy [AOR=2.7, 96%, CI (1.554-4.738)]. Neural foraminal stenosis was also significantly associated with the SLR(straight leg raise) test [AOR=2.0, 95% CI (1.026-4.083)].

Conclusion: There is an association between MRI findings and the clinical presentation of patients. Spinal canal stenosis and neural foraminal stenosis were associated with radiculopathy and older age. The lower lumbar levels are highly affected by DDD due to the higher mechanical stress at this level. Radiculopathy is the most frequent clinical presentation accompanying LBP, and Disc herniation was the commonest degenerative finding.

Keywords: LBP, MRI, LDDD, radiculopathy, disc degeneration, disc herniation, spinal canal stenosis, neural foraminal stenosis.

1. Introduction

1.1. Background

Low back pain (LBP) is a significant cause of disability and a prevalent health problem worldwide. It affects performance at work and general well-being (1). Low back pain is defined as pain, typically between the lower rib margins and the gluteal folds. Low back pain is usually accompanied by pain in one or both legs. In addition, some people with LBP have associated neurological symptoms in the lower limbs(2).

Low back pain is usually nonspecific or mechanical, which arises from the spine, intervertebral discs, or surrounding soft tissues. 97% of cases of LBP fall into the musculoskeletal or mechanical causes of pain. Among the causes of mechanical low back pain are lumbosacral muscle strain, disc herniation, lumbar spondylosis, spondylolisthesis, spondylolysis, vertebral compression fractures, and acute or chronic traumatic injury. Secondary to workplace injury, repetitive trauma and overuse are common causes of chronic mechanical low back pain(3,4). Backache may result from various causes; degenerative changes have been implicated as one of the leading causes of disability among the adult population. As a result, lumbar disc degeneration is targeted for diagnostic and surgical intervention (5,6).

Low back pain (LBP) has a high prevalence, affecting up to two-thirds of adults at some point in their lifetime (2). It is the second most common cause of disability in US adults (7). Between 70 and 90 % of individuals will experience back pain at some point in their lives(8).

The lumbar spine degenerative disc disease is almost universal with increasing age. The disc ages due to the deterioration of the proteoglycan within the disc, which becomes dehydrated. Therefore, the disc becomes narrower and this, in turn, narrows the nerve root canals where the lumbar nerve roots exit from the spinal canal. The commonest site of pain in the spine is the intervertebral disc. Degenerative tears often occur in the annulus, and these can be a source of pain. Neurological symptoms can also occur as a result of degenerative disease in the spine.

Tears of the annulus can allow part of the nucleus pulposus to herniate through the annulus. The weakest part of the annulus is the postero-lateral corner; thus, the nerve root is often compressed, resulting in compression of the cauda equina, which lies in the midline throughout most of the lumbar spine. This can cause loss of bowel and bladder function, necessitating an urgent surgical decompression (8).

Magnetic resonance imaging has proven to be an indispensable tool in clinical practice. Its value in assessing normal lumbar anatomy, internal disc chemistry and architecture, lumbar spine degeneration features, and in diagnosing herniated lumbar discs has been well documented(6). Plain radiography of the lumbar spine is appropriate to assess for fracture and bony abnormality, whereas magnetic resonance imaging is better for identifying the source of neurologic or soft tissue abnormalities (3).

Imaging is indicated when there are red flags, ongoing neurological symptoms that do not resolve, persistent or worsening pain, if malignancy is a significant concern, and if surgical intervention is likely to be required. Red flags include progressive motor or sensory loss, cauda equina syndrome, new urinary retention or overflow incontinence, history of cancer, recent invasive spinal procedure, and significant trauma relative to age (3,9,10).

1.2. Statement of the problem

Low back pain is the leading cause of activity limitation and absence from work throughout much of the world, imposing a high economic burden on individuals, families, communities, industry, and governments. Low back pain affects people of all ages, from children to the elderly, and is a frequent reason for medical consultations(11).

The lifetime prevalence of chronic low back pain is estimated as 60% to 70% in industrialized countries, with a one-year prevalence of 15 to 45%(11). Worldwide, 37% of LBP was attributed to the occupation, with two-fold variation across regions; Work-related LBP was estimated to cause 818,000 disability-adjusted life years lost annually (12).

According to a survey conducted in the US, 14% of respondents had back pain, and 2% had back pain with sciatica lasting at least two weeks(13). The physiologic cause of low back pain couldn't be determined in 85% of patients(14). In the 2002 US national health interview survey (NHIS), 26.4% of 30000 reported experiencing back pain in the prior 3months(15). In a similar study conducted in Saskatchewan, Canada, 50% had low-intensity back pain over the prior six months, while 11% had disabling back pain over the last six months(16). In 2006 the total costs of low back pain in the United States exceeded $100 billion per year (17).

In a systematic review conducted in Africa on 27 eligible studies, some findings support the global burden of disease of LBP. The mean LBP point prevalence among adolescents was 12% and among adults was 32%. The average one-year prevalence of LBP among adolescents was 33% and among adults was 50%. The average lifetime prevalence of LBP among adolescents was 36% and among adults was 62% (18). A similar systematic review study reported the annual prevalence of LBP in Ethiopia to be 54.05%. And the polled point prevalence of LBP to be 40.82%(19).

Lumbar degenerative disc diseases are one of the dominant causes of low back pain(6). In lumbar disc degeneration, accurate diagnosis is difficult, treatment is controversial, and failures are common(6). The ability to accurately reflect high-resolution disc morphology, nerve compression, and bone marrow make MRI an excellent tool to study the natural history of degenerative disc disease (20).

MRI can identify a lesion but cannot clearly indicate the details of the relationship between the finding and the patient's symptoms. For instance, more than 50% of asymptomatic persons show bulging or herniated discs on MRI or other imaging modalities. These could be regarded as normal findings unless clinical findings confirm their importance. Up to 85% of patients with low back pain cannot be given a definitive diagnosis. The importance of these findings can be determined only by precise correlation to the clinical findings. Excessive reliance on diagnostic studies without precise clinical correlation can lead to erroneous or unnecessary treatment of the lumbar spine’s degenerative disorders(21).

Despite the importance of identifying the relation between clinical features and MRI findings, insufficient information is available specifically on the relationship between patterns of clinical features and MRI findings. Therefore, this study was aimed at addressing their correlation.

1.3 Significance of the study

Low back pain has been implicated as the leading cause of disability. Degenerative disc diseases are frequently identified in imaging studies in both symptomatic and asymptomatic individuals. The significance of these imaging findings is determined only by precise correlation to the clinical findings(9,10).

This study aims to evaluate the correlation between MRI findings and clinical presentation in low back pain patients due to lumbar degenerative disc disease. Since MRI is an expensive and less accessible investigative modality, knowing the correlation would serve as an input to physicians to send appropriate investigations for the right patient. It will also assess the commonest type of lumbar degenerative disc disease, clinical presentations, and the pattern of lumbar disc level involvement.

Since there is no previous study done on the correlation of LDDD with MRI in Ethiopia, the significance of the study is high and it will serve as baseline data for further research. It will also contribute to the formulation of investigative guidelines.

2. Literature review

2.1 Pattern and correlation of MRI with clinical features

Lumbar degenerative disc disease is not easy to diagnose, as radiologic alterations of the disc do not necessarily mean disease. They become a disease when they are associated with typical symptoms. LDD is associated with genetic factors aging, smoking, lack of exercise, and obesity; people develop LDD more frequently while carrying out certain professional activities(22).

A study was conducted in Vivekanand polyclinic and the Institute of Medical Sciences, India, to evaluate the correlation between the clinical features of disc prolapse and magnetic resonance. In most of the patients, the duration of LBP was 1-2 years. Out of 75 patients participating, there were 44 patients with herniation, 25 patients had mild, and one patient had a moderate degree of thecal deformation. 21(28%) patients had one or more levels of foraminal effacement by herniated tissue, 100% of the patients had disc degeneration ranging from grade 1 to 3 at a different level. Radiculopathy was present in 54% (48 cases), 22 had right-sided & 20 had left-sided radiculopathy. The straight leg raise test was positive in 73% of patients. 35% of the patients had sensory deficits & had abnormal MRI findings at the same level as a sensory deficit. 39% of patients showed deep tendon reflex abnormality. 36% of patients had an L4-L5 level of disc involvement. A correlation was made between clinical findings(radiculopathy) and MRI findings, and 87% of the patients had a significant correlation, while 13% (10) of those patients had no significant correlation(23).

Another study in India on clinico-radiological correlation showed that males were more affected than females (62% vs. 38%). There were 100 patients involved, with the highest number of patients with CLBP were in their fifth, third, and fourth decades of life, respectively. In MRI of the L-S spine, degeneration was reported in 93%, followed by disc herniation in 38%, disc bulge in 30%, modic changes in 27%, and spinal canal stenosis in 44%. Out of the total positive cases of degenerative disc disease, the highest percentage was reported to have multiple level involvement (27.9%), followed by L5-S1(19.3%) & L4-L5(18.3%). The least involved was L2-

L3(9.6%). Out of the 38% of disc herniation, protrusion was the commonest type of disc herniation, followed by extrusion, and L5-S1 & L4-L5 were commonly involved levels. The least common type of disc herniation was sequestration(24).

In a similar study conducted in Iraq on 109 patients, it was found that the prevalence of LBP was to increase with increasing age. There was a significant gender predominance, with 2/3 patients being male (62% vs. 38%). The result concluded that men are more vulnerable to degenerative disease than females, possibly due to predisposition to injuries & mechanical stress due to their job. Disc degeneration was found to be present on multiple levels in 75% and on one level in 25% of the case. The most commonly affected levels were L4-L5(32%) & L5-S1(21.2%) and the lowest involvement at the L1-L2 vertebral level. The most common disc degeneration was grade II(48%), followed by grade III(26.5) and grade I (25%). Degeneration was found to be increasing with advanced age and was statistically correlated. Disc bulge was reported in 39.5%, Disc protrusion in 23.4%, disc extrusion in 7.8% of the total disc herniation cases. Modic changes, Schmoral nodes, HIZ, Facet joint degeneration were seen in 46.6%, 35.4%, 48%, 45.2% respectively. Commonly affected levels were L4-L5 & L5-S1 levels. Spondylolisthesis was seen in 17.4% at the L4-L5 level(25).

Disc protrusion and extrusion were significantly associated with spinal canal stenosis. Spinal stenosis was significantly associated with the positive leg raise test. Based on the severity of degeneration, mild to moderate degenerations were significantly associated with increased age. A significant association was also observed between ligamentum flavum hypertrophy and increasing age(24). A significant statistical correlation was found in another study between CLBP and disc degeneration, HIZ, modic changes, disc herniation, and facet joint arthropathy. In contrast, a non-significant correlation was found with spondylolisthesis and schmoral nodules(25).

According to an article published in the Journal of Clinical & Diagnostic research on MRI evaluation of degenerative disc disease, 109 patients were studied; men were affected more commonly in degenerative spinal diseases. Disc degeneration was observed in the fourth and

fifth decades of life. Multiple disc level involvement was reported, an average of 2.21 disc involvement per person, and L4-L5% involvement was frequently seen. Decreased disc height was typical at L4-S1(38.6%). Disc herniation in 62.24% of disc involvement, disc bulge in 27.39% of disc involvement, extrusion in 17.43% of disc involvement were reported, L4-L5 was the typical level for disc herniation and extrusion. In contrast, disc bulge was commonly seen at L3-L4 &L4-L5 levels. Spinal canal narrowing was seen in 23.24% and typically at the L4-L5 level. In 52.7% of discs involved in narrowing of lateral recess and compression of neural foramen, both were reportedly common at L4-L5. Spondylolisthesis was found between the L5-S1 vertebral body in 13.7% of patients, and anterolisthesis was typically seen. Spondylolisthesis was more commonly found in the patients of lumbar stenosis as compared to disc herniation, reflecting the fact that during stenosis, laxity of capsule and ligament may result in the development of spondylolisthesis(26).

In a cross-sectional study conducted in Pakistan, among 163 patients with a history of LBP and diagnosed with a degenerative disease, 58.3% were female. Most cases of disc degeneration were reported in the fourth and fifth decades. Most patients had bilateral sciatica (37.4%), and neurologic claudication was present in 28.3%. The study revealed that older patients had a higher level of lumbar disc degeneration (L1-L2, L2-L3, L3-L4), whereas young patients had a lower level of degeneration (L4-L5, L5-S1). The highest rate of degeneration was commonly found at L4-L5 (64.4%) & L5-S1(46.6%), and the least rate of degeneration was found at the L1-L2 level. Disc desiccation was present in all patients, primarily at L4-L5 &L5-S1 levels. Of the different aspects of degeneration evaluated in the study, disc herniation was most frequent (66.9%). And the others were lumbar stenosis (22.7%), facet joint arthropathy (2.5%), Disc bulge (70.6%), protrusion of IVD (63.8%), and extrusion (16.7%) were most commonly present at L4-L5 and L5-S1 levels. Narrowing of the neural canal, foramina and lateral recess, ligamentum flavum hypertrophy, and facet degeneration also occurred primarily at L4-L5 &L5-S1. Spinal nerve was pressed in 84.7% and commonly occurred at the level of L4-L5 & L5-S1. Spondylolisthesis was seen mostly at the level of L5-S1(27).

A study in Nepal, including 86 patients, had a mean age of 41 years ±8.79years. 57% were reported to be heavy workers. All patients had LBP and radicular leg pain. SLRT was positive in 82.6%. 90%had neurological deficit (motor & sensory).32.6% had absent ankle reflex. Disc herniation was seen on 174-disc levels. The most common type of herniation was disc protrusion and the commonest position being Centro-lateral and L4-L5 &L5-S1 being the commonest level in 74.1%. MRI finding of nerve root compression was significantly correlated with SLRT (p-value =0.035), absent ankle reflex (p-value <0.001) and neurological deficit (p-value= 0.019) (28).

In Manipal University, India, a study on the correlation between clinical features and MRI in lumbar disc prolapse was conducted. This study reported that multiple level disc herniations with foramen compromise were strongly associated with neurological signs. Central bulges and disc protrusions with thecal sac compression were mostly asymptomatic. In contrast, centrolateral protrusions and extrusions with neural foramen compromise correlated well with the dermatomal distribution of pain. Root compression observed in MRI did not produce neurological symptoms or deficits in all patients but when deficits were present, they correlated well with the presence of root compression in MRI. Logistics regression analysis for the association between MRI findings and clinical symptoms show that there is a significant association between evidence of neural foramen compromise seen in MRI and clinical symptoms (Odd's ratio 6.03, P<0.001) as well as between evidence of root compression seen in MRI and clinical symptoms (P<0.001)(29).

A study was conducted in Nigeria on the incidence & clinico-radiological findings in symptomatic patients with lumbar degenerative disc disease (LDDD). The incidence of LDDD was 11.5%. Among 160 patients diagnosed with LDDD, there was a 1:1.5 male to female ratio, and the mean age was 45.50±14.50. Almost all patients had altered sensation symptoms (99.4%), and bilateral radiculopathy was noted in 86.9% of patients. Impaired or complete loss of either fecal or urinary sphincter was noted in 11.9% of participants. The sciatic stress test (Lasegue's Test) was positive in 69% of patients. The study's imaging findings showed that all patients had osteophytosis and reduced IVD space (11.9%). Bulging annulus fibrosus (81.9%), hypertrophied ligamentum flavum (64.3%), canal stenosis (86.9%) & modic change were significantly present

among participants. modic grade 3 showed a statistically significant relationship with the clinical sign and symptoms. The lumbar IVD most involved in LDDD was L4-L5 (59.6) and L5-S1(18%). Spondylolisthesis was reported in 55.6% & 78.7% of this was located at L4-L5(30).

A similar study was done in Tanzania to determine the pattern of lumbar degenerative disc disease by using MRI and evaluating the relation between lumbar degenerative diseases with symptomatology. The study included 165 patients with low back pain ages ranging from 20 to 80 years. Female preponderance was observed (53% vs. 47%). The main presenting symptom was LBP, followed by radiculopathy. 80% of the patients presented with radiculopathy. 94% of patients had at least one degenerative finding. The commonest degenerative finding was disc degeneration in 83%, followed by nerve root compression in 77% and disc herniation in 63%and disc bulge in 39%. The commonest level of lumbar involvement in disc herniation was L4-L5 &L5-S1 in 74%. Modic changes prevalent in 28% of patients were common at L4-4L-5 & L5-S1 vertebral levels. Sciatica was reported as the main presentation of disc herniation. 76% of patients with LBP with radiculopathy had disc herniation as compared to 12% in those with LBP only. 33% of patients in the study had central canal stenosis and were frequently found at L4-L5 and L5-SL levels. Non was found at the L1-L2 level. The prevalence of canal stenosis was significant(p-value 0.000) among patients with radiculopathy and LBP(31).

A retrospective study conducted to review lumbar disc disease at Tikur Anbessa Hospital, Ethiopia, on 361 patients revealed There was a 1.5:1 male to female ratio. Patients' ages ranged from 20-81, and most were in their third, fourth, and fifth decades.70.1% of patients had disc prolapse, and 18.5% had disc bulge. Lumbar degeneration was most frequently seen at the L4-L5 level in 54.5% of patients($P<0.0001$) followed by L5-S1 in 140(24.7%) of patients. Both L4-L5 & L5-S1 accounted for 79.1% of the disc displaced. Disc displacement was central in 61.2%, lateral in 9.3%, and posterolateral in 15.8%. Pain, numbness, and neurologic claudication were the three most common presentations seen in 92.5%, 63.7%, and 30%, respectively. The SLR test was positive in 188 patients (51.6%) (32).

A study done on nurses in public hospitals in Addis Ababa to assess the prevalence and risk factors of LBP among Nurses showed the point prevalence of LBP was 45%(179). The prevalence of LBP was higher in females (74.0%) compared to males. Out of the total nurses who reported low back pain, 119(66.5%) had LBP for greater than four weeks. Radiation of pain to the lower extremities was reported by 111(62%) and extremity weakness by 82(45.8%)(33).

A similar study conducted in Eastern Ethiopia showed that the point prevalence of low back pain was 36.4%. The prevalence of low back pain was higher among females than males (65% vs. 35%). Seventy-four (48.1%) reported experience of radiating pain to the lower extremities(34).

The higher prevalence among females than males was because of anatomical, physiological and structural differences. And also, the effect of hormonal changes, gynecological problems, osteoporosis, menstruation, homemade activities and giving childbirths contribute to this difference(19,33).

Factors determining the prevalence of LBP were studied under individual, work-related and psychosocial conditions. Individual factors include age, gender, educational level, body mass index and personal habits. Work-related factors included heavy lifting, prolonged standing for more than an hour, frequent bending, inadequate rest interval and bad posture. And psychosocial factors refer to job satisfaction, work stress, and anger(33,34). A study in eastern Ethiopia found a significant association between low back pain and years of working experience, manual lifting, and working in an awkward posture(34). Work shift, physical activities at work, sleep disturbance and feeling little pleasure by doing things for the past one month were also significantly associated with LBP(33).

2.2 Anatomy of lumbar vertebrae

The spine is a collective term that comprises of a) Vertebral column which encloses the spinal cord and is formed anteriorly by the vertebral body and intervertebral disc and posterolaterally by the neural arch. b) The apophyseal joints, ligaments, and soft tissue that support the vertebral column. c) Neural tissue, i.e., the spinal cord and its nerve roots (6).

There are five lumbar vertebrae and five fibrocartilaginous lumbar intervertebral discs, which are load-bearing central bodies. The pedicles and lamina extend from the body and support two transverse processes and a single spinous process. The intervertebral disc separates the vertebral bodies and acts as a shock absorber. The nucleus pulposus, a remnant of the embryonic notochord, is more viscoelastic, centrally positioned, and is not innervated. The surrounding outer ring of innervated, elastic collagen provides for more structured support(4).

Disc Anatomy– The intervertebral disc interposed between two adjacent vertebral bodies named based on the vertebrae above and below them, for example, the L4- L5 disc is found between L4 and L5 vertebrae. They alleviate shock and transmit forces applied to the spine. It is composed of three parts– the cartilaginous endplate covers the superior and inferior vertebral body surface, the annulus fibrosus is a peripheral collagen fiber ring forming a limiting capsule to the nucleus pulposus and the centrally placed nucleus pulposus composed of a well-hydrated gelatinous matrix (6,35).

Lumbar disc disease is due to a change in the structure of the normal disc. Most of the time, disc disease comes from ageing and the degeneration that occurs within the disc(36). Degenerative spinal changes can be of: 1. Bony origin: Osteophytosis, facet hypertrophy, spondylolisthesis, and spondylolysis. 2. Discogenic origin: Disc desiccation, bulge, protrusion, prolapse/herniation. 3. Ligamentous origin: hypertrophy/thickening of spinal ligaments, especially ligamentum Flavum and posterior longitudinal ligament (6).

Risk factors causing lumbar disc degenerative disease and associated lumbosacral nerve compression includes; advancing age, socioeconomic status, torsional stress, smoking, obesity, heavy lifting, vibration, trauma, immobilization, psychosocial factors, gender, height, hereditary, genetic factors, and occupations like machine drivers, carpenters, and office workers(35).

2.3 MRI findings/features of Lumbar Degenerative Disc of Diseases

MRI is sensitive to disc conditions, especially degenerative disc disease, the extent of disc disease, whether disc bulge, protrusion, extrusion, or sequestration, and its effects on

cord/foraminal compression(28). The following terms and their descriptions are in use for the identifications of MRI findings of Degenerative Disc Diseases.

Disc Desiccation

- With time, the nucleus pulposus undergoes dehydration resulting in loss of height and intervertebral disc space. The disc becomes brittle, fibrous, and loses elasticity. This is seen as a progressive decrease in bright signal intensity of the central nucleus pulposus of the disc due to loss of water content on T2WI(6).

Disc degeneration (DD)

- It is associated with a decreased disc space, decreased signal intensity on T2W images, which indicates disc dehydration, disc bulging and herniation, and a high-intensity zone (HIZ) (25).
- HIZ represents a tear in the disc's annulus fibrosus seen as very bright signal intensity on T2 weighted images at the disc's posterior part. Annular fissures are a possible marker of clinically significant disc pathology. They can be located concentrically, transversely, or radially.
- A generalized disc bulge is a small circumferential overlap of the annulus over the vertebral endplates and may be associated with slight disc space narrowing. However, an abnormal disc bulge finding may be coincidental and does not always indicate pathology(9).

Disc herniations:

The Jensen classification system splits disc herniations into three categories: disc bulges, protrusions, and extrusions.

- Bulge is defined as symmetric extensions of disc material beyond the interspace.
- Protrusions are focal or asymmetric extensions of disc material beyond the interspace, with the herniation base being wider than the apex.

- Extrusions are defined as more extreme extensions of disc material beyond the interspace with the extruded component's dimension either wider than the base or not connected to the base (20).
- Sequestration: When the displaced disc material has completely lost any continuity with the parent disc, it is called sequestration (26).

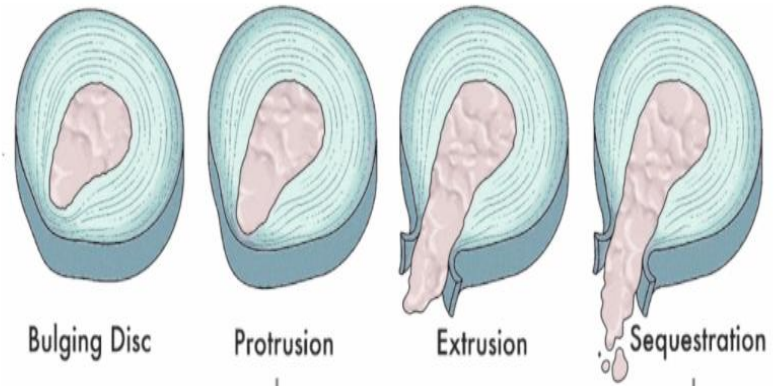

Figure 1: demonstration of types of disc herniation

Lumbar Spinal Stenosis

Another effect of degeneration is spinal stenosis. Spinal stenosis is classified based on etiology as either primary\congenital or secondary. And anatomically, it is classified as central, lateral and foraminal stenosis(37). Primary stenosis is very uncommon and involves spinal canal narrowing caused by a congenital abnormality. Secondary stenosis is the most frequent form and usually results from degenerative changes. It is most common in adults starting in the fifth and sixth decades of life(38).

Spinal stenosis can occur from disc disease, facet and ligament hypertrophy posteriorly, reducing the canal diameter from the posterior direction (39). Spinal stenosis most commonly is caused by degenerative osteoarthritis of the spine or spondylosis and occurs most frequently at the L4 to L5 level, followed by L3-L4, L5-S1, and L1-L2(37). The majority of spinal stenosis tends to occur

in lower lumbar levels as dorsal root ganglion diameter tends to be increased in this region, causing greater encroachment of the neural foramina. The lower lumbar segments also tend to have a greater incidence of spondylosis and degenerative disc disease, leading to an even greater predisposition to spinal stenosis and nerve root impingement(40).

Spinal canal stenosis is part of an ageing process. Lumbar spinal stenosis typically affects individuals over the age of 60 (38,40)). Additional risk factors for LSS include obesity or a family history of this condition. Other factors such as disc protrusion or bulging (for example, caused by progressive disc degeneration with aging or trauma), loss of disc height, facet joint arthropathy, osteophyte formation, or ligamentum flavum hypertrophy can all lead to encroachment on and narrowing of the central canal and neural foramina((38,40).

Lumbar spinal stenosis can involve the central canal, lateral recess, foramina or a combination of these. All of them start to be stenosed when there is the narrowing of disc space with or without disc bulging and ligamentum flavum hypertrophy(27).In cases of spinal canal stenosis due to disc bulge or herniation, thecal sac or nerve roots get impinged against the spine bone hence causing radiculopathy and movement-dependent pain (24). A spinal canal diameter less than 12 mm, indicates a narrowing of the canal(26).

The central spinal canal is anatomically formed by the posterior portion of the vertebral body, the pedicles and the lamina on either side, and the connection of the lamina at the transverse process. The other two crucial structures surrounding are ligaments: the ligamentum flavum and posterior longitudinal ligament(41). Central spinal canal stenosis is a result of a decrease in the anteroposterior, transverse, or combined diameter secondary to loss of disc height with or without bulging of the intervertebral disc, hypertrophy of facet joint, and ligamentum flavum(42).

Structures that form the Neural foraminal are the vertebral body, pedicles, disc, superior and inferior articular processes, ligamentum flavum, and zygapophysial joint(43). Lateral recess stenosis is due to facet joint arthropathy with osteophyte formation and overgrowth of the

superior articular facet. Foraminal stenosis is due to loss of disc height, osteophyte formation, and foraminal disc protrusion which produce compression of the exiting nerve root(42).

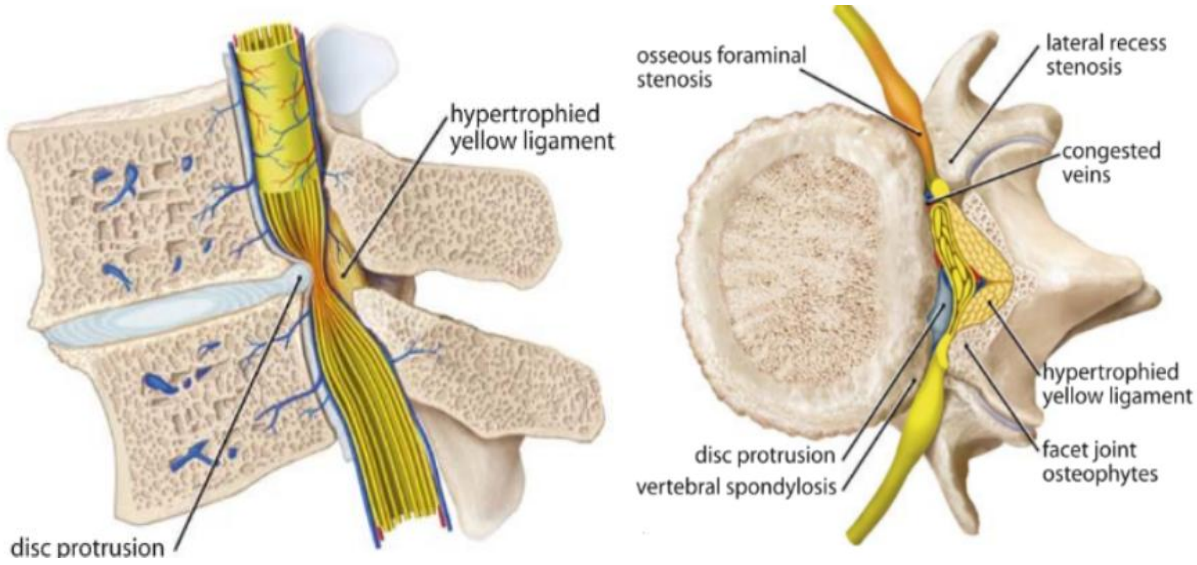

Figure 2: Pathomorphology of central, lateral recess and foraminal stenosis(44)

Spondylolisthesis

- It is measured and diagnosed by the methods of Meyer ding. The anteroposterior diameter of the lower vertebral body's superior surface is divided into four equal parts. It is Graded as I, II, III, and IV if there is a corresponding slip of <25%, 25-50%, 50-75%, and >75% (26).

2.4 Clinical presentation of patients with lumbar disc disease

A patient's clinical presentations are essential diagnostic tools to identify lumbar disc degeneration. Symptoms and clinical presentations associated with lumbar disc degeneration and lumbosacral nerve lesion are discogenic pain, Radicular pain, and radiculopathy (muscular weakness and cutaneous innervation defect). Lower extremity radicular pain and radiculopathy problems due to lumbar disc degeneration are caused by compression of neural structures in the lumbosacral region.

Lumbar disc degeneration may compress neural structures, resulting in lumbosacral nerve roots and lumbosacral plexus lesions. Lesion of these structures results in radicular pain, weakness, numbness, or difficulty controlling specific muscles of the lower extremities, buttocks, lower abdomen, and groin regions. Numbness, tingling, weakness in the extremities, and severe pain that tends to come and go are also nerve compression features in the lumbosacral region. In the case of radicular pain, only radiating pain is present from an inflamed or compressed nerve root. As an example, an inflamed nerve root in the lower back may radiate pain into the leg, while in the case of radiculopathy, the motor loss may occur when a compressed or inflamed nerve root results in neurological deficits, such as problems with reflexes, numbness, and/or weakness. Both syndromes frequently occur together, and radiculopathy can be a continuum of radicular pain.

Lumbosacral radiculopathy: lesion of the lumbosacral plexus by lumbar disc degeneration, and is divided clinically into those affecting the lumbar plexus and the sacral plexus.

- Patients with lumbar plexus lesion clinically present with weakness of hip flexion, knee extension, thigh adduction, and sensory loss in the lower abdomen, inguinal region, and over the entire medial, lateral, and anterior surfaces of the thigh, and the medial lower leg. In lumbar plexus lesions, a decrease or absence of knee jerk is common. L2, L3, L4 radiculopathy usually presents as patients experience low back pain that radiates to the anterior aspect of the thigh, which may progress into the knee and possibly to the medial part of the lower leg and the foot. In L5 radiculopathy, patients complain of pain that radiates down the lateral leg into the foot(45)
- Lesions of the sacral plexus result in weakness of the posterior thigh and muscles of the leg and feet. In sacral plexus lesions, the muscular weakness of the lower extremities is significant. These include weakness in hip extension, hip abductors and internal rotators, knee flexion, and all muscles of the leg and foot supplied by the peroneal and tibial nerves. The diminished sensation may involve the posterior aspect of the thigh, anterolateral, and posterior aspects of the leg below the knee and almost the entire foot. The ankle jerk may be diminished or absent(35).S1

radiculopathy involves radiation of sacral or buttock pain into the posterior aspect of the patient's leg, into the foot, or the perineum(45).

- Cauda equina syndrome: cauda equina is a horsetail-like continuation of the spinal nerve root below the first or the second lumbar vertebrae(46). Nerves of the cauda equina are often compressed by a herniated disc resulting in cauda equina syndrome. Compression could also occur due to trauma, stenosis, tumor, or lumbar region synovial cyst(47). The characteristic presentation of patients with cauda equina syndrome is loss of function of the sphincter(46).

Straight leg raising (SLR)

It is the most commonly used method to diagnose lumbar disc degeneration and associated lumbosacral nerve lesions. The patient lies in the supine position, and the leg is elevated from the ankle, with the knee remaining straight. Normal patients can elevate the leg 60 to 90 degrees without pain. If the patient cannot lie supine, this test can be done in a lateral position(24,35). The extent of root compression determines the extent of pain and then the different degrees of positivity of the Lasègue sign. The intensity of pain elicited depends on the degree of extension of the leg on the thigh(48).

Interpretations

1. Pain in leg raising up to 30- It is diagnostic of intervertebral disc prolapse.
2. Pain in leg raising between 30 –70– Suggestive of intervertebral disc prolapse.
3. Pain on raising leg > 70– equivocal(24,35).

3. Objective

3.1 General objective

- To identify the correlation and patterns of clinical presentation and MRI findings in patients with low back pain due to lumbar degenerative disc disease in the Ortho-spine unit at TASH, Addis Ababa, Ethiopia, from April 1, 2020, to Mar 30, 2021

3.2 Specific objective

- To determine the pattern and spectrum of MRI findings of Lumbar degenerative disc disease in patients with low back pain.
- To determine the common clinical presentations of patients with Lumbar degenerative disc diseases.
- To evaluate the correlation between MRI findings and clinical features of lumbar degenerative disc disease.

4. Method and material

4.1- Study area and period

The study was conducted at Ortho-spine unit TASH in Addis Ababa, Ethiopia. TASH is under the College of Health Sciences of Addis Ababa University (AAU), one of the country's pioneer universities. The hospital is a tertiary level referral and teaching hospital providing service to people from all corners of the country in its various departments such as internal medicine, surgery, orthopedics, gynecology and obstetrics, pediatrics, radiology, neurology, radiotherapy, adult oncology, pediatric oncology /hematology, nuclear medicine, psychiatry, laboratory, pharmacy, etc. It gives undergraduate, graduate, postgraduate, and several subspecialty training programs in medical and health sciences. The radiology department is equipped with high-tech radiologic devices, including CT scan machines, a 1.5T MRI machine, x-ray machines, and ultrasound machines. This study was conducted from March 25 to May 25, 2021.

4.2- Study design

- An institutional-based retrospective cross-sectional study was conducted.

4.3- Source and Study population

4.3-1. Source population

- All Adult patients who came with LBP at Regular OPD of Ortho-spine unit who had Lumbosacral MRI at TASH.

4.3-2. Study population

- All adult patients who came with LBP at the Ortho-spine unit who had Lumbosacral MRI and were diagnosed with Lumbar disc degenerative disease at TASH from April 1, 2020, to Mar 30, 2021.

4.4- Inclusion and Exclusion criteria

4.4-1. Inclusion criteria

- Patients with an MRI scan who have a history of LBP due to degenerative disc disease
- Patients diagnosed with degenerative disc disease.

4.4-2. Exclusion criteria

The following group of patients were excluded.

- Patients with incomplete or unavailable medical records
- Patients with a history of acute trauma to the back
- Patients with no MRI (incomplete report on MRI)
- Patients who have undergone any form of lumbar surgery
- Patients with known primary malignancy (spine/other sites)

4.5- Sample size determination and sampling procedure

4.5-1. Sample size determination

The sample size was determined by using a single population proportion formula. The following assumptions were made while calculating the sample size; a 95% confidence level, a margin of error (0.05). There were no published papers on the correlation between clinical features and MRI findings of lumbar degenerative disc disease among patients presenting with LBP in Ethiopia. So using the result of a study in Tanzania, the percentage of LDDD patients with radiculopathy was 80% (25).

$$n = \frac{(Z\alpha/2)2\ p\ (1-p)}{d2}$$

Where: P = 80% (proportion of patients with symptomatology)

Zα/2 = critical value at 95% confidence level of certainty (1.96)

d= the margin of error between the sample and the Population or desired precision (5%)

n = sample size

$$n = \frac{(1.96)^2 \times 0.8(1-0.8)}{0.05^2} = 245.86 \simeq 246$$

4.5-2. Sampling procedure

A simple random sampling technique was used to select the patients' medical records with LBP fulfilling the inclusion criteria during the study period.

4.6Variables

4.6.1 Dependent Variable

- Lumbar Degenerative Disc Disease (Disc herniation, disc degeneration, spinal canal stenosis, neural foraminal stenosis, facet joint hypertrophy, ligamentum flavum thickening, spondylolisthesis)

4.6.2 Independent variable

- Clinical presentation of the lumbar degenerative disc disease: Radiculopathy, SLRT, extremity weakness, bowel and bladder incontinence.

4.7 Term and operational definition

Low back pain: is defined as any non-traumatic musculoskeletal disorder affecting the low back. It included all back pain that was not secondary to another disease or injury cause (e.g., cancer or motor vehicle accident).

Radiculopathy: impairment of a nerve root, usually causing radiating pain, numbness, tingling, or muscle weakness that corresponds to a specific nerve root.

Lumbar degenerative disc disease: Lumbar degenerative disc disease constitutes a group of degenerative pathologic changes that are evident as age increases.

Disc Herniation classification

- ➢ Normal: No disc extension beyond the interspace.
- ➢ Disc bulge: Circumferential symmetrical disc extension beyond the interspace.
- ➢ Disc protrusion: Focal or asymmetrical disc extension beyond the interspace with the base against the parent disc broader than any other diameter of the protrusion.
- ➢ Disc extrusion: Focal obvious disc extension beyond the interspace with the base against the parent disc narrower than the diameter of the extruding material itself or no connection to the parent disc.

Spinal canal stenosis: Is the decrease in the anteroposterior, transverse, or combined diameter secondary to loss of disc height with or without bulging of the intervertebral disc, hypertrophy of facet joints, and ligamentum flavum.

Neural foramen stenosis: This is the decrease in the openings of the foramen due to loss of disc height, osteophyte formation, and foraminal disc protrusion producing compression of the exiting nerve root.

Age group: younger age group is age less than 40, and the older age group is age 40 and above.

4.7-Data collection instruments, techniques, and data collectors

Patients' medical records were recruited into the study when they have an MRI scan and have LBP due to Lumbar degenerative disc disease, and patients with the absence of the imaging studies were excluded from the study. Imaging findings were filled in the data collecting sheet provided for this study. Lumbosacral MRI was done with the standard protocol that generally includes a sagittal T1-weighted spin-echo sequence, a sagittal T2- weighted spin-echo sequence, and \axial T2-weighted images.

Data collection was conducted after receiving ethical clearance to conduct this study from the ethical review committee of TASH. Demographic data of participant patients, such as age, gender, and presenting symptoms, and duration, were collected from the eligible patient data. Clinical data and MRI were obtained from the patient's medical records. The data collectors and Principal Investigator collected the data on the structured data collection format using the Kobo toolbox and then was transferred into SPSS. Before collection, data collectors were trained for two days on basic data collection skills. The Structured checklists were tested on 5%(13 medial record cards). All data collectors and the principal investigator participated in pre-testing and standardization of the checklists. Problems highlighted during the pretest were corrected before the start of the data collection. Each question was properly coded.

4.8 Data processing and analysis

The data were collected and entered into Kobo Toolbox version 1.27.3, which secured further data quality by reducing errors made during data entry. Then entered data was transported to the SPSS version25 software package for analysis. For descriptive analysis, simple frequencies tables, percentages, mean, bar chart, and pie chart were used. Chi-square test and binary logistic regression were used to check for the association between the outcome variable and the independent variables.

The difference in proportion using the chi-square test is considered to indicate statistical significance at a p-value of 0.05. Using binary logistic regression Variables that yield a p-value of <0.25 in the bivariable analysis were considered as a candidate for multivariable logistic regression analysis. For measuring the strength of the association between the outcome and independent variables, crude odds ratio (COR) and adjusted odds ratio (AOR) along with 95% confidence interval (CI) were calculated. Finally, statistical significance was declared at a p-value <0.05.

4.9- Ethical considerations

Ethical clearance was obtained from the Department of Anatomy Research Ethics Review Committee (DRERC), and Institutional Review Board (IRB), Addis Ababa University. An official letter or clearance was sent to the department of orthopedics to get permission for data collection. The obtained result was presented anonymously by omitting the names of patients.

4.10- Dissemination of results

The study will be submitted to Addis Ababa University, College of Health Sciences, School of medicine, Department of Anatomy. The study's findings will also be shared with the ortho-spine unit and other concerned bodies. Furthermore, It will be submitted to medical journals for possible publication.

5. Result

5.1 Socio-Demographic characteristics

During the study period, 246 patients' medical record data were obtained, analyzed, and summarized. In the study, 142(57.7%) patients were female, and 104(42.3%) were male. The age range is from 18-77 years, and the median reported age (Q1, Q3) was found to be 48.5 years (39,60). Of the total patients, 71.9% were less than 60years, and 28.0% were age greater than 60years. In patients less than 60 years, 45.5%were in the age group 40-59, and 26.4% were age <39. Most were in their fifth, sixth, and fourth decade of life (figure 1).

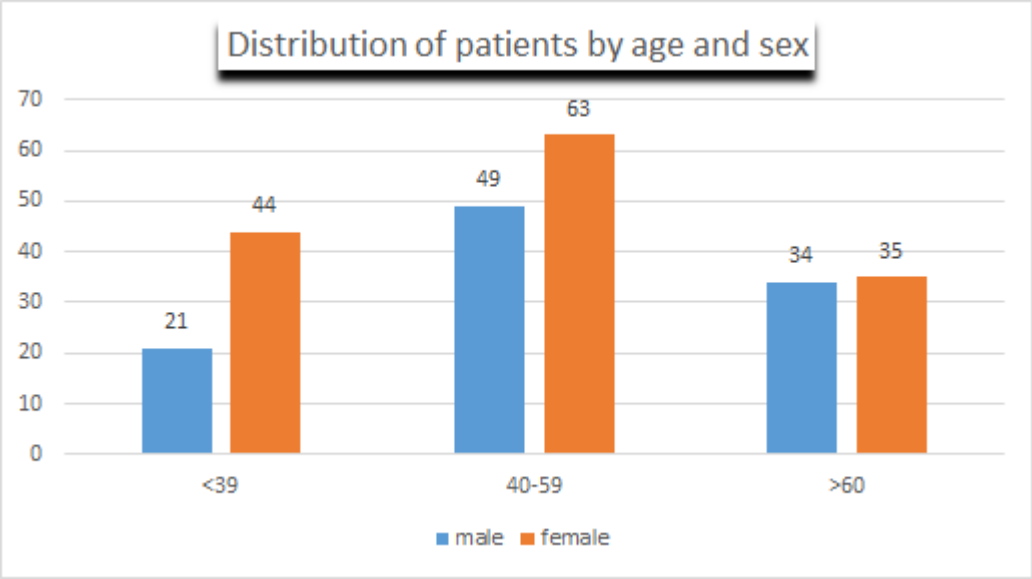

Figure 1: Socio-Demographic distribution of study participants attended at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

5.2 Clinical presentation

All included patients had complaints of low back pain. The duration of low back pain was less than four weeks in 1(0.4%), 4-12 weeks in 36(14.6%), and greater than 12weeks in 209 (85%) of

the patients. Of the patients with low back pain (LBP) 56.5% reported radiculopathy. Other less frequently reported symptoms are extremity weakness and bowel and bladder incontinence in 6.1% and 4.5%, respectively. A straight leg raise test (SLRT) was done in 160 patients and was positive in 89 (55.6%).

Table 1: Percentage distribution of patients according to their clinical presentation at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Clinical presentation		**frequency**	**Percentage (%)**
Radiculopathy	present	139	56.50%
	absent	107	43.50%
Bowel and bladder incontinence	present	11	4.50%
	absent	235	95.50%
Extremity weakness	present	15	6.10%
	absent	231	93.90%
Straight leg raise test (SLRT)	positive	89	55.60%
	negative	71	44.60%
	Not done	86	

In 139 patients (56.5%) with radiculopathy, bilateral involvement was most commonly observed in 76(54.7%). Compared to bilateral involvement, right and left side unilateral involvement were less commonly observed in 38(27.3%) and 25(18.0%) of patients consecutively.

5.3 Degenerative findings on MRI

There were different aspects of degeneration evaluated in this study. Disc degeneration was seen in 133(54.1%) of the patients. There were a total of 261 levels of disc involvement. Single-level involvement was seen in 40(31.3%) patients, two-level disc involvement in 53(41.7 %) patients and more than three-level involvement in 34(26.8%) patients with disc degeneration were seen. The most typical level of disc involvement was at L4-L5 in 98 (37.4%) discs and L5-S1 in 75 discs (28.6%) (Table 3).

Decreased disc height was seen in 15.4% of patients. It involved a total of 66 vertebral levels and was common at L4-L5 and L5-S1 disc levels (40.9% and 34.8%, respectively). Disc dehydration was found in 52(21.1%) patients involving 114 vertebral levels. It was also common at L4-L5 (35.1%) and L5-S1(28.1%) vertebral levels (table 3).

Facet joint hypertrophy was present in 35 (14.2%) of patients. It was present at 73 vertebral levels and was mainly observed at L4-L5 and L5-S1 levels, accounting for 30(41.1%) and 26(35.6%) cases, respectively(table3). Other less frequently seen degenerative features include spondylolisthesis, annular disc tear, and modic change. They were observed in 6.1%, 2.8%, 4.9%, respectively.

Disc degenerative findings (disc degeneration, facet joint hypertrophy, spinal canal stenosis, neural foramen stenosis, and disc bulge) were dependent on age (Table 2).

Table 2: Frequency distribution of degenerative imaging findings among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Degenerative changes	Age Group				
	<39 n=65	40-59 n=112	>60 n=69	total	P-value

Disc degeneration	27	63	43	133	0.045
Ligamentum flavum thickening\hypertrophy	1	7	16	24	0.000
Facet joint hypertrophy	3	18	14	35	0.026
Disc bulge	37	56	51	144	0.050
Disc protrusion	19	3	15	37	0.202
Disc extrusion	1	3	2	6	0.844
Disc sequestration	0	1	1	2	0.662
Spinal canal stenosis	18	50	41	109	0.001
Neural foraminal stenosis	32	57	50	139	0.007
Spondylolisthesis	4	8	3		0.747

P-value is calculated using chi-square test

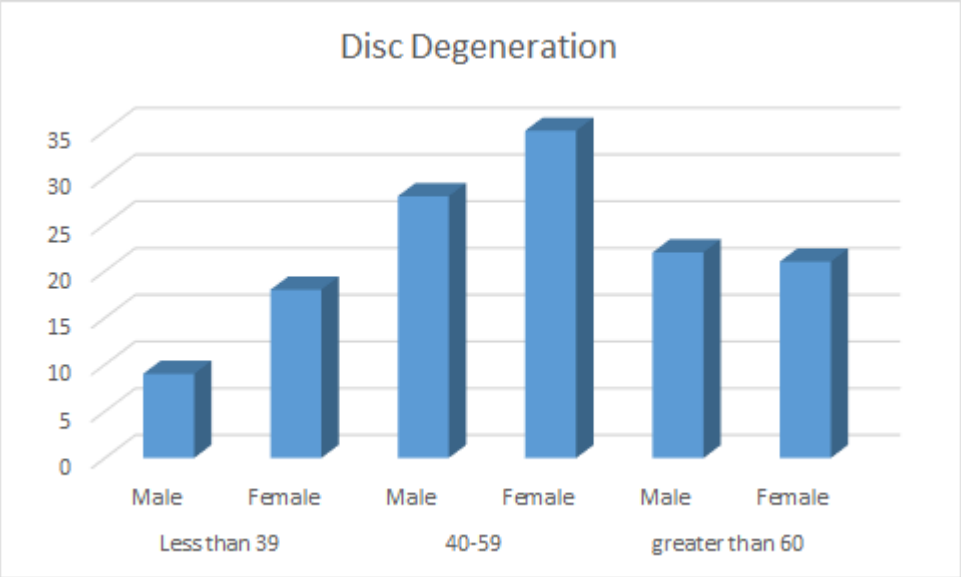

Figure2 Distribution of disc degeneration across age and sex among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Types of disc herniation

Disc herniation was observed in 204(82.9 %) of the patients. A total of 219-disc herniation was detected, in which disc bulge was seen in 144(65.8%), disc protrusion in 67(30.6%), disc extrusion in 6(2.7%), and extrusion with the migration of the disc material(sequestration) in only 2(0.9%) of disc involvement were seen.

The most commonly involved level in disc bulge cases was L4-L5, followed by L5-S1 in and L3-L4. The second most common type of herniation was protrusion. In most cases, L4-L5 and L5-S1 levels were involved. Extrusion was observed at eight levels; among these, three were at L5-S1. The least commonly seen type of herniation was sequestration (2 cases). It was present at L3-L4 and L5-S1 levels. Of the total patients with disc herniation, 124(60.8%) presented with

low back pain and radiculopathy, while 80(39.2%) patients were presented with only low back pain.

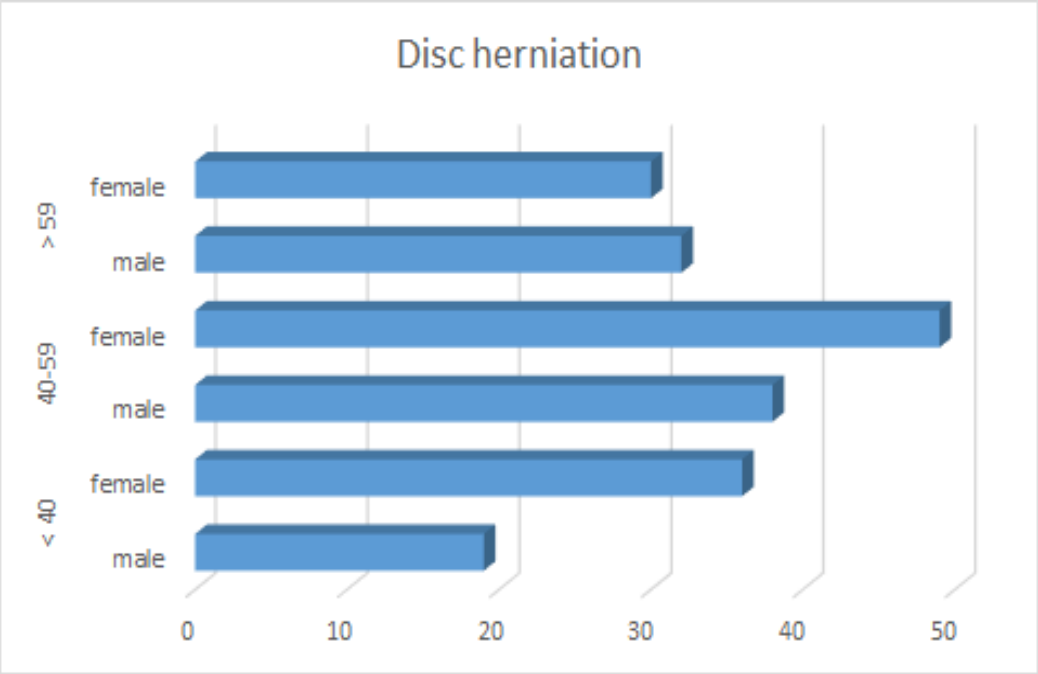

Figure 3: Distribution of disc herniation according to age and sex among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

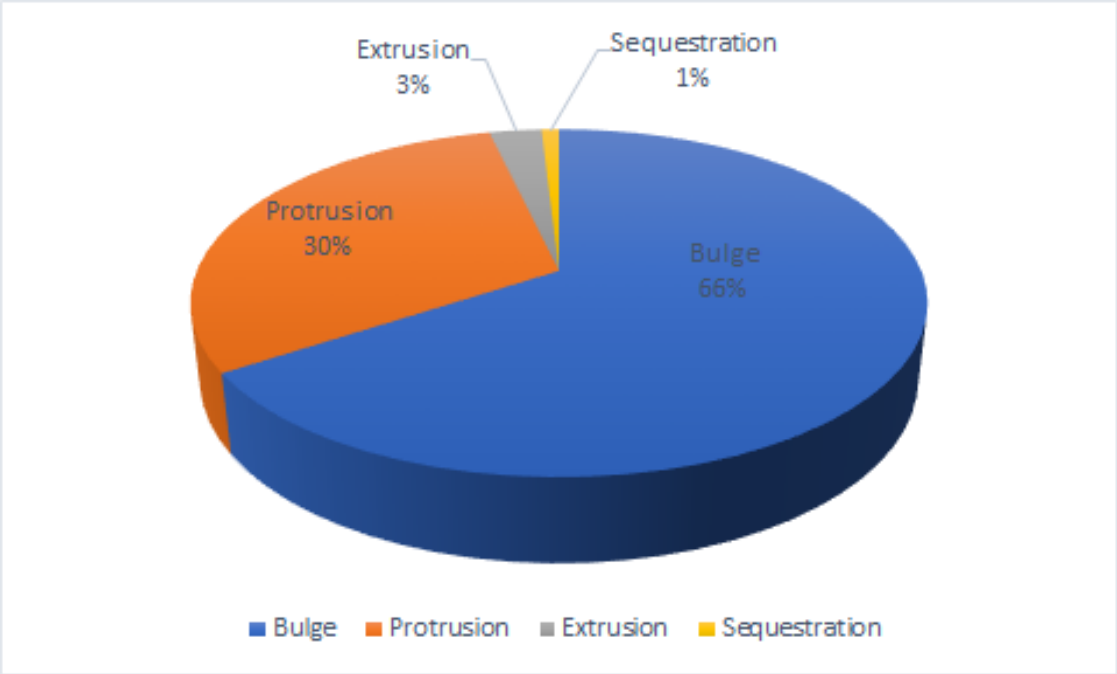

Figure 4: Pie chart shows the percentage of types of disc herniation among patients at the Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Spinal canal stenosis was present in 109 (44.3%) patients. The highest number of patients suffered mild stenosis, 58 (50.9%), followed by moderate stenosis in 31(27.2%) and severe stenosis in 25(21.9%) patients. Mild stenosis was highest in the second age group (40-59 years). The percentage of patients with the severity of stenosis worsened in the age group >60, followed by age 40-59 years (figure 5).

In the 58 cases of mild spinal canal stenosis. Multiple-level involvements were seen in 31 patients and single-level involvement in 27 patients. The L4-L5 and L5-S1 levels are primarily involved in 41(40.6%) and 32(31.7%) of the levels involved, respectively. Moderate spinal canal stenosis was observed in 31 patients most frequently at L4-L5 and L5-S1, accounting for 20(37.7%) and 17(32.1%) spinal levels involved. Fifteen patients had a single level of involvement, while the rest had multiple levels of involvement. In 25 cases of severe spinal canal

stenosis, 43 spinal levels are involved. Fifteen cases (55.8 %) of severe stenosis were present at the L4-L5 spinal level.

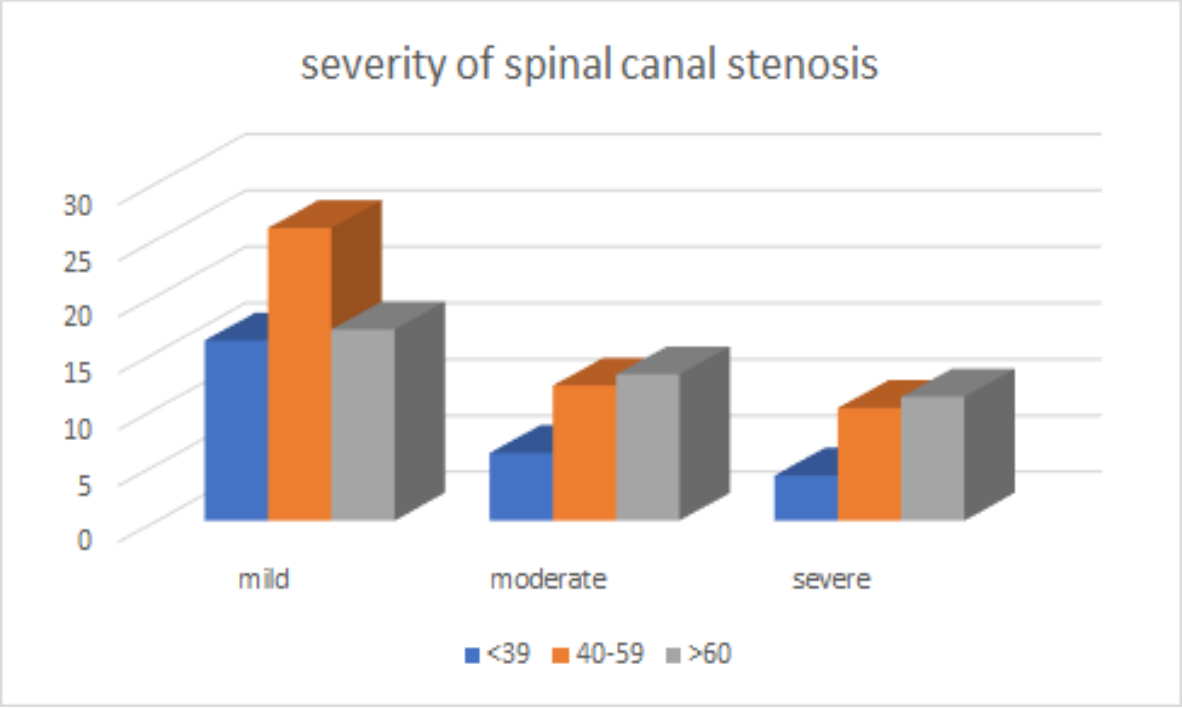

Figure 5: Age vs severity of spinal canal stenosis among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Neural foraminal stenosis was present in 139 (56.6%) patients. It involved a total of 268 levels. Mild neural foraminal stenosis was the commonly involved type in 48.9%, followed by moderate in 30.6% and severe in 20.5% of the patients.

Table 3: The pattern of lumbar involvement among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1
1. Disc degeneration (n=262)	5.0% 13	9.2% 24	19.8% 52	37.4% 98	28.6% 75
2. Disc desiccation (n=114)	9.6% 11	9.6% 11	17.5% 20	35.1% 40	28.1% 32
3. Disc height reduction (n=66)	6.1% 4	4.5% 3	13.6% 9	40.9% 27	34.8% 23
4. Ligamentum flavum thickening (n=52)	_	9.6% 5	21.2% 11	38.5% 20	30.8% 16
5. Facet joint hypertrophy (n=73)	2.7% 2	5.5% 4	15.1% 11	41.1% 30	35.6% 26
6. Disc bulge (n=291)	3.4% 10	8.2% 24	22.3 65	38.8% 113	27.1% 79
7. Disc protrusion (n=97)	5.2% 5	2.1% 2	8.2% 24	48.5% 47	36.1% 35
8. Disc extrusion (n=8)	_	25% 2	25% 2	12.5% 1	37.5% 3
9. Disc sequestration (n=2)	_	_	50% 1	50% 1	
10. Spinal canal stenosis (n=196)	0.5% 1	7.1% 14	19.4% 38	43.3% 85	29.6% 58

11. Neural foramen stenosis (n= 268)	2.6% 7	7.8% 21	14.6% 39	41.4% 111	33.6% 90

5.4 correlation of MRI findings with clinical presentation

Binary logistic regression analysis for the association between MRI findings (like disc degeneration, disc herniation, spinal canal stenosis and neural foraminal stenosis,ligamentum flavum hypertrophy, disc dehydration, disc height loss) and clinical presentations (like radiculopathy, extremity weakness, bowel and bladder incontinence, and SLR test).

In this study using bivariable analysis disc degeneration, disc herniation, spinal canal stenosis, and neural foraminal stenosis were associated with clinical presentation. Whereas ligamentum flavum hypertrophy, disc dehydration, and disc height loss did not associate with clinical presentation.

In this study using bivariable analysis disc degeneration, disc herniation, spinal canal stenosis, and neural foraminal stenosis were associated with clinical presentation. Whereas ligamentum flavum hypertrophy, disc dehydration, and disc height loss did not associate with clinical presentation

In the bivariable analysis result, Disc degeneration was 2.3 times more associated with patients over 60 than patients with less than 39years (p-value 0.017) [COR=2.3, 95%CI:1.164-4.655]. Disc herniation was also significantly associated with radiculopathy [COR=2.79, 95%CI (1.398-5.568)].

In multivariable analysis, a statistically significant correlation was found between spinal canal stenosis and radiculopathy. Spinal canal stenosis was also significantly associated with age groups greater than 40(Table 4).

Table4: Bivariable and multivariable logistic regression analysis of the association of Spinal canal stenosis with age and radiculopathy among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Explanatory Variable	Column1	Frequency	COR 95% CI	AOR 95% CI	P-value
Age	<39	65	1	1	
	40-59	112	2.18(1.130-4.217)	2.19(1.119-4.287)	0.022*
	>60	69	3.6(1.747-7.426)	3.7(1.753-7.691)	0.001*
Radiculopathy	Absent	107	1	1	
	Present	139	2.4(1.38-3.95)	2.4(1.388-4.072)	0.003*

*Significantly associated variables in multivariable analysis

Similarly, in multivariable analysis, a significant association was seen between neural foramen stenosis and clinical presentation; radiculopathy, extremity weakness, and SLR test. Neural foramen stenosis was also significantly associated with the age group greater than 60(Table5).

Table 5: Bivariable and multivariable logistic regression analysis of the association of Neural Foraminal stenosis with clinical presentation among patients at Ortho-spine unit in TASH, April 1,202-March 30, 2021.

Explanatory Variable		Frequency	COR 95% CI	AOR 95% CI	P-value
Age	<39	65	1	1	
	40-59	112	1.1(0.580-1.970)	1.2(0.629-2.408)	0.543
	>60	69	2.7(1.324-5.564)	3.425(1.560-7.519)	0.002*
Radiculopathy	Absent	107	1	1	
	Present	139	2.9(1.706-4.856)	2.7(1.554-4.738)	0.000*
Extremity weakness	Absent	231	1	1	
	Present	15	5.4(1.193-24.511)	3.3(0.669-15.908)	0.144
SLR test	Negative	71	1	1	
	not done	86	1.8(0.941-3.350)	1.6(0.826-3.211)	0.159
	Positive	89	2.1(1.096-3.904)	2.0(1.026-4.083)	0.042*

*Significantly associated variables in multivariable analysis

6. Discussion

A hospital-based cross-sectional study on Degenerative Disc Disease among patients with low back pain was conducted. It investigated the socio-demographic characteristics of the subjects, the anatomical site or level of different degenerative disc diseases, and their correlation with the presenting symptoms of the subjects. Studying the pattern, spectrum, and association of magnetic resonance imaging (MRI) findings and clinical presentation helps determine the exact source of pain and its management.

The Median age of the study group was 48.5 years. LBP was higher in the fifth, sixth, and fourth decades of life consecutively. A previous study published in Ethiopia TASH also showed that most patients presented in their third, fourth, and fifth decades of life (32).

Low back pain was found slightly higher among female patients than male patients. Female preponderance with a male to female ratio of 1:1.4 was seen in this study. This finding goes in line with previously done studies(27,30,31,34). This might be due to differences in the structural or anatomical body composition of males and females. In addition, it could also be due to the effect of hormonal changes, childbearing, osteoporosis (19,33,34), and female gender roles that include both household activities and outside work that require lifting heavy loads and standing for a prolonged time period. On the contrary, other studies showed men to be more prone to low back pain (24,25,32)

In this study, all patients had LBP. About 85% had chronic low back pain, which is comparable to a similar study in Uttar Pradesh, India that reported the duration of low back pain to be 1-2 years (23). In different studies, the main presentations of patients accompanying LBP were radicular symptoms(27,31). In the current study, radiculopathy and altered sensation in 56.5% of the cases. Around 54.7 % of patients had bilateral radiculopathy, right side unilateral in 27.3% & left unilateral in 18%. The percentage of cases presenting with radiculopathy was comparable to a previous study conducted in Eastern Ethiopia (48.1%)((19,33,34). However, the percentage of patients with radiculopathy in this study was significantly higher than another similar study done

in Bhopal, India (24), which was 27%. This might be due to a smaller sample size used in the other study. In two different studies conducted at Bhopal and Uttar Pradesh, India, the right unilateral involvement was commonly seen (23,24)

Bowl and bladder incontinence is a characteristic feature in diagnosing patients with cauda equina syndrome due to compression of the nerve root in the lumbar and sacral region(46). In the current study, bowel and bladder incontinence was found in 11(4.5%) of patients. A similar study conducted in Bhopal, India, reported a comparable result of 3% (24). On the other hand, this was higher compared to a study from Nigeria (30).

In the present study, SLRT was positive in 55.6% of the cases. The result was close to a previously conducted study in Ethiopia TASH, reporting a positive SLR test in 51.6% of patients(32). This result was slightly higher than a study in Bhopal India(24) and lesser than other studies done in Uttar Pradesh India and Nigeria(23,31). The lower percentage of patients with positive straight leg raises could be due to the small sample size used in their study.

Disc degeneration, disc height reduction, disc dehydration, disc herniation, spinal canal stenosis, ligamentum flavum thickening, and facet joint hypertrophy are significant imaging findings in this study. These Imaging findings were the results seen among participants. Disc herniation was more common among other aspects of degeneration. This result was also seen in other studies(27,32). In contrast, some other studies reported disc degeneration to be the most common finding(25,31).

In the present study, multiple level disc involvement was commonly seen, and very few had a single level disc degeneration. Similarly, this finding was observed in other studies(24,25,27). In the current study, degeneration affected all spine levels, but the most frequently involved levels were L4-L5 & L5-S1, and the lowest involvement rate was seen at L1-L2. Similar outcomes have been reported by previously done studies(25,26). This could probably be due to the highest mechanical stress at this level(26). The L4-L5 & L5-S1 being the junction sites between the mobile lumbar and non-mobile sacral region of the spine, might also be the reason for the higher frequency of degeneration at this spinal level(30).

According to different works of literature, the prevalence of disc degeneration significantly progresses as age increases (31,39). There was a statistically significant association between the prevalence of disc degeneration and increasing age(31). This finding was similar to the observation made in the current study. Using bivariable analysis, an association between increasing age and disc degeneration was seen [COR=2.3, 95%CI:1.164-4.655].

Using MRI findings, this study found disc herniation in 82.9% (204) of patients. Another study conducted in Uttar Pradesh India also reported disc herniation as the commonest type of degeneration(23). In the current study, disc bulge was the most frequent among the other types of herniation. Its percentage was higher than disc prolapse, 70.6 % vs. 32.8%. This finding was similar to a study in Bhopal, India, revealing 30% vs 23% disc bulge and prolapse, respectively(24). On the contrary, a previous study in Ethiopia TASH, states that prolapse was higher among aspects of disc herniation than disc bulge(32). This difference in result could be attributed to increased availability of the scanner and the use of the latest and more sensitive MRI scan machine with high resolution that generates high-quality images, making it capable to pick bulges in early stages.

In the present study, disc bulge and protrusion were most frequently seen at L4-L5 and L5-S1 levels. Disc extrusion was commonly seen at L5-S1, and two cases of extrusion with migration(sequestration) were seen at L3-L4 and L4-L5 levels. The least level of spinal level involvement in herniation was seen at L1-L2 & L2-L3 levels. Concurrently other studies also suggested that the prevalence of herniation at the L4-L5 and L5-S1 levels is higher than other levels. The lower the lumbar level the higher the prevalence of disc herniation. The higher workload and mechanical stress exerted at these lower lumbar spine levels could explain this finding(24,27,32).

According to different literature, the main presentation of patients with herniation was LBP and radiculopathy(31). This is due to the compression of neural structures in the lumbosacral region by the bulging or protruding disc element (35). In this study, 60.8% of patients with disc herniation had both low back pain and radiculopathy, and our finding agrees well with this fact.

Spinal canal stenosis was present in 44.3% of patients. In the severity of spinal stenosis, the frequency of mild was highest, followed by moderate and severe, respectively. This result is equivalent to a similar study in Bhopal India which reported spinal stenosis in 44% of patients and a higher frequency of mild spinal stenosis(24). However, the finding in this study is higher than the prevalence reported in Tanzania (30%) (31)and Pakistan(27). This discrepancy in the percentage is probably due to the increased sample size in this study.

In the current study, spinal stenosis was frequent at L4-L5 followed by the L5-S1 level, which is a similar result reported by other studies(24,26,31). The lower lumbar level has an increased predisposition to stenosis because of a higher incidence of spondylosis and degenerative disc disease at this level(40).

In the current study, spinal canal stenosis was significantly associated with increasing age. Spinal canal stenosis was associated 2.2 times with the age group 40-59 [AOR=2.18, 95% CI(1.130-4.217)] years and 3.6 times with the age >60 years[AOR=3.6, 95% CI(1.747-7.426)] . Most patients with spinal stenosis were of an older age group—stenosis results from degenerative changes to the spine. Spinal stenosis is part of an aging process(40). Spinal stenosis could be the result of disc disease narrowing the disc space. These conditions include disc bulging, facet and ligament hypertrophy posteriorly, reducing the canal diameter from the posterior direction(27,39).

In this study, LBP with radiculopathy was a typical clinical presentation in patients with spinal canal stenosis. There was a significant association between spinal canal stenosis and radiculopathy [AOR=3.6, 95% CI(1.38-3.95)]. This finding was in concordance with the result in another study(31). Radiculopathy is due to impingement of the nerve against the spine bone(24).

According to the findings of this study, neural foramen stenosis was present in 56.6%(139) patients. Commonly involved levels were L4-L5 and L5-S1 spinal levels. Mild stenosis was common in 48.8%. In a similar study, the prevalence of neural foramen stenosis was comparable, which reported 52.7% of disc involvement. The spinal level commonly involved was similar to the present finding (26,31). Neural foramen stenosis and nerve root compression occur in lower lumbar levels as dorsal root ganglion diameter increases in this region, causing more significant

encroachment of the neural foramina(40). neural foramen stenosis was significantly associated with age >60years[AOR=3.4, 95% CI(1.560-7.519)]

In this study, neural foramen stenosis significantly correlates with radiculopathy [AOR=2.7, 96% CI (1.554-4.738)]. Radiculopathy was 2.7 times more associated with the finding of neural foramen stenosis seen on MRI. A similar study also found that logistics regression analysis for the association between MRI findings and clinical symptoms showed a significant association between evidence of neural foramen compromise and root compression seen in MRI and clinical symptoms(29).

In the current study, the straight leg raise test also significantly correlated with neural foramen stenosis MRI findings [AOR=2.0, 95% CI (1.026-4.083)]. A similar study also reported an association between nerve root compression and the SLR test (28).

7. Conclusion

An association has been observed between patterns of MRI findings and the clinical presentation in lumbar degenerative disc disease patients. Radiculopathy was the commonest clinical presentation accompanying LBP in patients with degenerative disc diseases. Disc herniation was the commonest degenerative finding. The lumbar discs most affected by DDD were the lower lumbar levels (L4-L5 & L5-S1). Spinal canal stenosis and neural foraminal stenosis were significantly associated with radiculopathy. Neural foraminal stenosis is associated with SLRT. The presence of spinal canal stenosis and neural foramen stenosis was crucial in determining the clinical presentation of the patients.

8. Strength and limitation

- ➢ One of the strengths of this study is that it used a larger sample size and was extensive compared to previous studies. It included variables that were not studied in previous research.

➢ To ensure the data quality during data collection, it used the Kobo toolbox.

➢ This study has some limitations.

- It was conducted in a single tertiary level referral hospital where a high number of patients with the case or pathology came. Therefore, this study can not be inferred to the general population.
- Since the study was retrospective, secondary data was used, and variables couldn't be studied due to the data not being found or being underreported.

9. Recommendation

- for researchers: to study
  - Further on Multi-centred or population-based studies with a larger sample size are recommended to make a statistically significant conclusion. It is also recommended to do this research using a different study design to study the correlation of underreported variables.
  - The social and economic impact of LDDD.
  - The association between the anatomical site of disc herniation with spinal stenosis and neural foraminal stenosis.
  - The association between severity and duration of LBP with LDDD

➢ For clinicians:

- It's best to order an MRI scan In patients presenting with low back pain and radiculopathy since there is a statistically proven correlation with MRI findings of spinal canal stenosis and neural foramen.

- It’s seen from the result of this study that the patients in the working-age group account for the highest percentage of low back pain secondary to LDDD. In addition to this, the percentage of female patients was higher than the number of males affected. Therefore it’s recommended that physicians create awareness about proper protective measures such as risk factors for LDDD (personal, psychosocial factors, and work-related factors), proper ergonometric, regular exercise habits especially core exercises, and the importance of early neurologic examination in patients with low back pain.

➢ For policymakers

- Occupational health and safety training is probably recommended in order to minimize the work-related risk factors of low back pain.

10. Reference

1. Kaplan W, Wirtz VJ, Mantel-Teeuwisse A, Stolk P, Duthey B, Laing R. Priority medicines for Europe and the world 2013 update; 2013. WHO Library. 2018;165–6.

2. Wáng YXJ, Wu A-M, Ruiz Santiago F, Nogueira-Barbosa MH. Informed appropriate imaging for low back pain management: A narrative review. J Orthop Translat. 2018 Oct;15:21–34.

3. Will J, Bury D, Miller JA. Mechanical low back pain. In: Encyclopedia of Pain. Berlin, Heidelberg: Springer Berlin Heidelberg; 2006. p. 1105–1105.

4. Manusov EG. Evaluation and diagnosis of low back pain. Prim Care. 2012 Sep;39(3):471–9.

5. Choi Y-S. Pathophysiology of degenerative disc disease. Asian Spine J. 2009 Jun;3(1):39–44.

6. Jain M, Vijaywargiya M. Degenerative changes in Lumbar spine on MRI: A retrospective study. International Journal of Medical Research and Review. 2016 Jun 30;4(6):1030–4.

7. Freburger JK, Holmes GM, Agans RP, Jackman AM, Darter JD, Wallace AS, et al. The rising prevalence of chronic low back pain. Arch Intern Med. 2009 Feb 9;169(3):251–8.

8. Russell RCG, Williams NS, Bulstrode CJ, editors. Bailey & Love's Short Practice of Surgery. 23rd ed. Hodder Education Publishers; 2000. 1348 p.

9. Borenstein D, Calin A. Fast Facts: Low Back Pain. Health Press Limited;

10. Tonosu J, Oka H, Higashikawa A, Okazaki H, Tanaka S, Matsudaira K. The associations between magnetic resonance imaging findings and low back pain: A 10-year longitudinal analysis. PLoS One. 2017 Nov 15;12(11):e0188057.

11. Ch6_24LBP.pdf. Available from: https://www.who.int/medicines/areas/priority_medicines/Ch6_24LBP.pdf

12. Punnett L, Prüss-Utün A, Nelson DI, Fingerhut MA, Leigh J, Tak S, et al. Estimating the global burden of low back pain attributable to combined occupational exposures. Am J Ind Med. 2005 Dec;48(6):459–69.

13. Deyo RA, Tsui-Wu YJ. Descriptive epidemiology of low-back pain and its related medical care in the United States. Spine . 1987 Apr;12(3):264–8.

14. Deyo RA, Rainville J, Kent DL. What can the history and physical examination tell us about low back pain? JAMA. 1992 Aug 12;268(6):760–5.

15. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. Spine . 2006 Nov 1;31(23):2724–7.

16. Cassidy JD, Carroll LJ, Côté P. The Saskatchewan health and back pain survey. The prevalence of low back pain and related disability in Saskatchewan adults. Spine . 1998 Sep 1;23(17):1860–6; discussion 1867.

17. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. J Bone Joint Surg Am. 2006 Apr;88 Suppl 2:21–4.

18. Louw QA, Morris LD, Grimmer-Somers K. The prevalence of low back pain in Africa: a systematic review. BMC Musculoskelet Disord. 2007 Nov 1;8:105.

19. Jegnie M, Afework M. Prevalence of Self-Reported Work-Related Lower Back Pain and Its Associated Factors in Ethiopia: A Systematic Review and Meta-Analysis. J Environ Public Health. 2021 Aug 24;

20. Beattie PF, Meyers SP. Magnetic resonance imaging in low back pain: general principles and clinical issues. Phys Ther. 1998 Jul;78(7):738–53.

21. Cox JM. Low back pain : mechanism, diagnosis, treatment. In: Published in **2011** in Philadelphia by Wolters Kluwer/Lippincott Williams & Wilkins Health. Philadelphia : Wolters Kluwer/Lippincott Williams & Wilkins Health, c2011.; 2011.

22. Schröder C, Nienhaus A. Intervertebral Disc Disease of the Lumbar Spine in Health Personnel with Occupational Exposure to Patient Handling-A Systematic Literature Review and Meta-Analysis. Int J Environ Res Public Health [Internet]. 2020 Jul 4;17(13). Available from: http://dx.doi.org/10.3390/ijerph17134832

23. Bajpai J, Saini S, Singh R. Clinical correlation of magnetic resonance imaging with symptom complex in prolapsed intervertebral disc disease: A cross-sectional double blind analysis. J Craniovertebr Junction Spine. 2013 Jan;4(1):16–20.

24. Rai GS, Mehra A, Gaur TNS. A prospective study of magnetic resonance imaging findings in patients of chronic low back pain: a clinico-radiological correlation. International Journal of Research in Medical Sciences. 2016 Dec 24;4(1):47–56.

25. Bakr KI, Sadiq IM, Nooruldeen SA. Lumbosacral MRI Findings in Chronic Lower Back Pain. IJPHRD. 2020 Jan 31;11(1):1206–11.

26. Suthar P, Patel R, Mehta C, Patel N. MRI evaluation of lumbar disc degenerative disease. J Clin Diagn Res. 2015 Apr;9(4):TC04–9.

27. Saleem S, Aslam HM, Rehmani MAK, Raees A, Alvi AA, Ashraf J. Lumbar disc degenerative disease: disc degeneration symptoms and magnetic resonance image findings. Asian Spine J. 2013 Dec;7(4):322–34.

28. Rijal A, Paudel M. Correlation between Clinical Features and Findings Observed on Magnetic Resonance Imaging in Patients with Lumbar Disc Prolapse. Asian Journal of Orthopaedic Research. 2020 Jan 24;26–33.

29. Janardhana AP, Rajagopal, Rao S, Kamath A. Correlation between clinical features and magnetic resonance imaging findings in lumbar disc prolapse. Indian J Orthop. 2010 Jul;44(3):263–9.

30. Ajiboye LO, Oboirien M, Buunaaim Alexis DB. The incidence and clinico-radiological findings in symptomatic adult patients with lumbar degenerative disc diseases in a tertiary orthopaedic hospital, South-West, Nigeria. East African Orthopaedic Journal. 2018;12(1):27–32.

31. Jacob M, Akoko LO, Kazema RR. Lumbar Disc Degenerative disease: Magnetic Resonance Imaging Findings in Patients with Low Back Pain in Dar Es Salaam. East and Central African Journal of Surgery. 2015;20(1):122–31.

32. Biluts H, Munie T, Abebe M. Review of lumbar disc diseases at Tikur Anbessa Hospital. Ethiop Med J. 2012 Jan;50(1):57–65.

33. Belay MM, Worku A, Gebrie SA, Wamisho BL. Epidemiology of low back pain among nurses working in public hospitals of Addis Ababa, Ethiopia. East and Central African Journal of Surgery. 2016 Jul 11;21(1):113–31.

34. Mijena GF, Geda B, Dheresa M, Fage SG. Low Back Pain Among Nurses Working at Public Hospitals in Eastern Ethiopia. J Pain Res. 2020 Jun 8;13:1349–57.

35. Liyew WA. Clinical Presentations of Lumbar Disc Degeneration and Lumbosacral Nerve Lesions. Int J Rheumatol. 2020 Aug 29;2020:2919625.

36. Lumbar Disk Disease (Herniated Disk) [Internet]. [cited 2021 Aug 22]. Available from: https://www.hopkinsmedicine.org/health/conditions-and-diseases/lumbar-disc-disease-herniated-disc

37. Siebert E, Prüss H, Klingebiel R, Failli V, Einhäupl KM, Schwab JM. Lumbar spinal stenosis: syndrome, diagnostics and treatment. Nat Rev Neurol. 2009 Jul;5(7):392–403.

38. Atlas, Steven J, Delitto A. Spinal Stenosis: Surgical versus Nonsurgical Treatment. Clin Orthop Relat Res. 2006 Feb;443:198.

39. Kasdan RB, Howard JL. Neuroimaging of spinal diseases: a pictorial review. Semin Neurol. 2008 Sep;28(4):570–89.

40. Munakomi S, Foris LA, Varacallo M. Spinal Stenosis And Neurogenic Claudication. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.

41. Peabody T, M Das J. Anatomy, Back, Vertebral Canal. In: StatPearls. Treasure Island (FL):

StatPearls Publishing; 2021.

42. Wu L, Cruz R. Lumbar Spinal Stenosis. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2020.

43. Choi YK. Lumbar foraminal neuropathy: an update on non-surgical management. Korean J Pain. 2019 Jul 1;32(3):147–59.

44. Boos N, Aebi M, editors. Spinal Disorders: Fundamentals of Diagnosis and Treatment. Springer, Berlin, Heidelberg; 2008.

45. Dydyk AM, Khan MZ, M Das J. Radicular Back Pain. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.

46. Marks S. The cauda equina syndrome. Clin Risk. 2006 Jan 1;12(1):25–8.

47. Berg EJ, Ashurst JV. Anatomy, Back, Cauda Equina. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.

48. Manfrè L, editor. Spinal Canal Stenosis. Springer, Cham; 2016.

Annex 1: Checklists

MRN No……

No	Question	Response & code	Remark
Section 1: socio-demographic			
101	Age	1. <20 years 2. 20-29 3. 30-39 4. 40-49 5. 50-59 6. 60-69 7. 70-79 8. >80	
102	sex	1. Male 2. Female	
Section II: Clinical data			
201	LBP	1.Yes 2.No	
202	LBP duration	1. <4weeks 2.4-12 weeks 3.>12week	
204	Radiculopathy	1.Yes 2.No	

205	If the answer to Qn. no 204 is present which type?	1.Bilatateral 2.Right side/unilateral 3.Left side/ unilateral	
208	Straight leg raises test (SLRT)	1.Positive 2.Negative	
209	IS traight leg raises test (SLRT) positive	1.Bilatateral 2.Right side/unilateral 3.Left side/ unilateral	
209	Bowel and bladder incontinence	1.Present 2.Absent	
	Extremity weakness?	1. Present 2. Absent	
210	Other additional symptoms	_____	
Section III: MR Imaging findings			
	Imaging findings on MRI		**If yes or present what vertebral level is involved? (L1-L2, L2-L3, L3-L4, L4-L5, L5-S1)**
Vertebral bone and Intervertebral disc degenerative changes			
301	Osteophytes?	1.present 2. absent	

302	Endplate changes\ Modic Changes (MC)	1.present 2. absent	
303	If Modic Changes (MC), what type?	1. Type I 2. Type II 3. Type III	
304	Disc desiccation/dehydration	1.present 2. absent	
305	Reduced disc height?	1.present 2. absent	
307	High-intensity zone(HIZ)	1.present 2. absent	
308	Disc herniation(Schmorl nodes)?	1.present 2. absent	
309	If the answer is present/yes to Qn. 311, which type of herniation is present?	1.Disc bulge 2. Disc protrusion 3. Disc extrusion 4.Sequestration	
310	Spinal canal stenosis?	1.present 2. absent	
311	Narrowing of exit foramina/Neural foraminal stenosis?	1.present 2. absent	
314	Spondylolisthesis?	1.present 2. absent	

315	If the answer to Qn. 313 is present/yes, which type/grade is present?	1.GradeI (<25%) 2.GradeII (25-50%) 3.GradeIII (50-75%) 4.Grade IV (>75%)	
316	Ligamentum flavum thickening?	1.present 2. absent	
316	Facet joint hypertrophy?	1.present 2. absent	