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RESEARCH ARTICLE

Correlation Between Direction of Prolapsed Intervertebral Disc (PIVD) And Lumbar Vertebral Alignment

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Abstract

Purpose: The purpose of this research was to establish a link between direction of a prolapsed intervertebral disc (PIVD) and lumbar vertebral alignment. **Methods:** This cross-sectional study included 102 participants with prolapsed intervertebral discs in the lumbar segment and lumbar vertebral mal-alignment of both sexes between the ages of 30 and 50 who had undergone MRI and X-ray for the lumbo-sacral spine. The Numerical Pain Rating Scale (NPRS) was used to assess outcome, MRI scans were used to determine the direction and amount of PIVD, and lumbar spinal alignment was assessed using X-rays in the AP and lateral views. SPSS version 26.0 was used for statistical analysis. **Findings:** Among the 102 participants, The study found that only 2.94% of 102 participants had Prolapsed Intracranial Disc Disease (PID) at the L1-2 level, with many on multiple levels. Prolapsed intervertebral discs were prevalent in 46.07% of individuals, with scoliosis in 33.33%, exaggerated lumbar lordosis in 4 subjects, and anterolisthesis in 20.59%. The study found a significant correlation between posterocentral and anterolisthesis, biforaminal and flatback, right paracentral and left paracentral prolapse and scoliosis ($p<0.0001$), with biforaminal direction being particularly significant for anterolisthesis and retrolisthesis ($p=0.0050$, 0.0014). The lumbosacral angle had a mean value of 31.79, and the mean of pain on rest was 1.99±1.38 and during activity was 5.51±1.66. **Conclusion:** It concluded that there was a significant relationship between the direction of prolapsed intervertebral disc (PIVD) and lumbar vertebral alignment.

Keywords
Anterolisthesis, Lumbar lordosis, Lumbosacral angle, Pain, Scoliosis

INTRODUCTION

A herniated lumbar disc, commonly referred to as a lumbar disc herniation (LDH), is a typical cause of sciatica, low back pain, and radicular limb discomfort. It is described as a localised displacement of disc material outside of the intervertebral disc space that causes myotomal or dermatomal discomfort, weakness, or numbness (Kreiner et. al., 2014, Vander , 2010).

A heterogeneous set of musculoskeletal illnesses known as low back pain (LBP) affects 65-85% of people worldwide (Satpute et. al., 2019; Ozturk et. al., 2006). LBP has become a more complicated and multidimensional issue in the second decade of the twentieth century, with rising prevalence, time frame, expenses, and rising severity and co-morbid conditions (Shinde & Bhende, 2023; Shinde et. al., 2022) It also appears to be expanding globally at this time. Bad posture can

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cause muscle imbalance, which leads to a dysfunctional connection between different parts of the body (Avaghade et. al., 2023).

The most frequent differential diagnoses for LBP are lumbar disc herniation (LDH) and degenerative disc degeneration (Amin et. al., 2017). One of the most common musculoskeletal conditions is lumbar prolapsed intervertebral disc (PIVD) or herniation, which affects 10% of the population (de Carvalho et. al., 2016; Thakeray et. al., 2010; Gadiya et. al., 2016). There are numerous physical and social factors for low back pain, which contribute to the 92% incidence of PIVD in the Indian population (Ranganatha et. al., 2020). LDH was found most commonly at the L4-L5 region (40%), followed by the L5-S1 region (36.8%), the L2-L3 region, and the L1-L2 region (each contributing 13.2%) (Takatalo et. al., 2011). There are reports of a 5% to 18% prevalence of recurrent LDH (Kapetanakis et. al., 2019). A significant portion of clinically significant herniation attacks occur in persons between the ages of 30 and 50, but they can also happen in adolescents and the elderly, with a 2:1 male to female ratio (Andersen et. al., 2019; Jordan et. al., 2009). According to studies, LDH is present in 24–27% of asymptomatic individuals (Harper & Klineberg, 2019; Jensen et. al., 1994). LDH is most frequently idiopathic, however it can also develop as a result of trauma or physiological disc degeneration brought on by ageing (Zhang et. al., 2023). Other risk factors for lumbar disc herniation include obesity, smoking, diabetes, connective tissue disorders, and genetic predisposition (Sharrak & Khalili , 2022).

A number of changes in the intervertebral disc, such as a decrease in water retention in the nucleus pulposus, an increase in the ratio of type 1 collagen in the nucleus pulposus and inner annulus fibrosus, and the deterioration of collagen and extracellular material, all contribute to lumbar disc herniation (Al Qaraghli & De Jesus, 2023). The nucleus pulposus shifts through the annulus fibrosus, typically posteriorly, resulting in stenosis or narrowing of the central canal and mechanical compression of the thecal sac or accompanying nerve roots (Zhang et. al., 2023). The main signs and symptoms of LDH are low back discomfort spreading to the back of the thigh and leg, numbness and paraesthesia in the appropriate dermatome, weakness, and depressed reflexes in the appropriate myotome (Wang et. al., 2014). The manner a patient presents can vary depending on where the herniation is in respect to the thecal sac and nerve roots. Patients with central stenosis who have lumbar disc herniations that are pressing posteriorly on the thecal sac may experience neurogenic claudication. Additionally, pain is made worse by walking, standing, and with lumbar extension, and it is made better by truncal flexion or rest. In the most severe disc herniations, the thecal sac can become critically stenotic, leading to cauda equine syndrome, which presents with symptoms like acute urinary retention, faecal or urinary incontinence due to overflow incontinence, saddle anaesthesia, and sexual dysfunction (Wu & Cruz, 2022; Davis et. al., 2023). Additionally, sciatica may result from lumbar/pelvic muscular spasm impinging a lumbar/ sacral nerve root (Davis et. al., 2023). A herniated intervertebral disc is discovered in about 85% of sciatica sufferers (Ropper & Zafonte, 2015). Long distance driving, manual labour, carpentry, barbering, and office work increase the risk of LDH in middle-aged working men.

The protrusion of the disc material may be posterocentral or central, posterolateral, paracentral, foraminal, anterior, or anterolateral, and it may also alter the symptoms. The posterior longitudinal ligament experiences posterior central protrusion, which may be the source of low back pain. A rip in the longitudinal ligament, which results from postero-lateral prolapse, harms the growing nerve root. Pain on trunk flexion, sensory deficits, muscle weakness, altered reflexes, or decreased lumbar lordosis are all symptoms of both central and foraminal pain. Anterior or anterolateral disc prolapse is relatively uncommon and is characterised by symmetrical or asymetrical discomfort that is felt across the L4-5 region or may radiate to the buttock or thigh and worsens with extension. A protective accentuation of the lumbar lordosis is a clear symptom (Kotwal & Mittal, 2020).

Patients with LDH may experience paravertebral muscle soreness, scoliosis, trunk shift, and imbalanced spinal sagittal alignment, which can cause a variety of issues for both individuals and society. The emergence of these symptoms may lead to specific changes in the sagittal and coronal shapes of the spine (Wu et. al. 2019). The pathogenesis of lumbar spine illnesses as well as the health-related quality of life in both paediatric and adult populations are significantly

and measurably impacted by the sagittal alignment of the lumbar spine. With ageing and degenerative disorders, the sagittal alignment of the lumbar spine might shift (Berven & Wadhwa, 2018). Patients with lumbar illness may experience chronic low back pain as a result of abnormal sagittal spinal alignment (Endo et. al., 2010). These aberrant spinal alignments include scoliosis, spondylolisthesis, hypolordosis, and hyperlordosis. According to earlier research, significant fat infiltration of the paravertebral muscles and LDH are typically present together, and muscular disease can also cause scoliosis (Wang et. al., 2022). The development of an upright, bipedal posture and gait depends on lordosis in the lumbar spine, a peculiar characteristic of the human spine (Berge, 1998). Studying the pathophysiology of lumbar developmental and degenerative disorders requires an understanding of lumbar lordosis as well as the link between lumbar lordosis, pelvic incidence, and balance or alignment of the spine (Berven & Wadhwa, 2018). Spondylolisthesis is defined as the anterior slippage of one vertebral body with respect to the adjacent vertebral body that results in mechanical or radicular symptoms or pain, whereas retrolisthesis is defined as the backward slippage of one vertebral body on another that has also been linked to back pain and function impairment (Tenny & Gillis, 2023; Shenoy et. al., 2019).

The incidence of LDH has increased as society and modern lifestyles have changed. LDH results in substantial medical costs in addition to a decreased quality of life. It has been demonstrated that living with LDH costs the patient and society a lot of money (Pourahmadi et. al., 2016). The literature has a number of studies on lumbar spine sagittal alignment and lumbosacral morphology (Antoniades et. al., 2000). In other words, any disc herniation may result in changes in lumbosacral morphology. On the other hand, LDH may develop as a result of changed lumbosacral morphology. However, the relationship between the direction of PIVD and lumbar alignment has received little attention, and to our knowledge, no study has been done that simultaneously examines the lumbar alignment and the direction of PIVD. The objective of the study was to clarify the relationship between the direction of PIVD and the alignment of the lumbar vertebrae. The research hypothesis was to evaluate the correlation between direction of prolapsed intervertebral disc (PIVD) and lumbar vertebral alignment.

MATERIALS AND METHODS

Particpants

A total of 102 participants of both sexes were randomly chosen for this cross-sectional study, which was conducted using the computerised SPSS software. Participants had to be between the ages of 30 and 50. The study included about 61 women and 41 men. Participants who had undergone MRI and X-ray for the lumbo-sacral spine and had been diagnosed with prolapsed intervertebral disc in the lumbar segment with lumbar vertebral mal-alignment were eligible to participate in this study. This study did not include participants who had undergone spinal fusion and fixation. This study complied with ethical standards and received approval from the Institutional Ethical Committee of Krishna Vishwa Vidyapeeth, KIMSDU, under reference number (Protocol Number 615/2022-2023). The participant gave informed consent along with the volunteer form covering study details, risks, benefits, confidentiality, and participant rights. The study prioritized the rights and welfare of the participant in the design, procedures, and confidentiality measures, strictly adhering to the ethical principles of the Declaration of Helsinki.The goal of the study was explained to the participants, and they were informed about the procedure. Each was evaluated for pain using the Numerical Pain Rating Scale (NPRS), the direction and level of PIVD were observed in MRI images, lumbar spinal alignment was evaluated by observing X-rays in the AP and lateral views, and observations were made. A correlation of the findings from each was performed to establish a relationship between them.

Data Collection Tools

Numerical Pain Rating Scale (NPRS)

The Numerical Pain Rating Scale (NPRS) is frequently employed to measure pain intensity, in which patients are asked to select a number (from 0 to 10) to represent their pain severity. Test- retest reliability was ICC=0.991 (Alghadir et. al., 2018).

Direction and level of the prolapse

This was observed on MRI. The disc material may protrude in a number of orientations, including the posterolateral, paracentral, right- and left-paracentral, biforaminal, anterior, and

anterolateral. Although rather uncommon, a prolapsed in the anterior direction is possible (Kotwal & Mittal, 2020)

Lumbar spinal alignment in the Anteroposterior (AP) and lateral view

Scoliosis was evaluated from an AP perspective and graded using Cobb's method. The upper border of the highest vertebra in the scoliotic curve and the lower border of the lowest vertebra in the scoliotic curve are both crossed by a straight line. Cobb's angle is the angle created by a perpendicular from these lines. Scoliosis is categorised into three grades: grade 1 for angle between 10° and 20°, grade 2 for angle under 40°, and grade 3 for angle above 40°. In the lateral view, spondylolisthesis, retrolisthesis, and lordosis were visible.

Spondylolisthesis and retrolisthesis was calculated with the Tillard's equation and graded using the Meyerding classification. The classification system divides slip into five grades: 0% to 25% is Grade I, 25% to 50% is Grade II, 50% to 75% is Grade III, 75% to 100% is Grade IV, and greater than 100% is Grade V. A line is drawn through the posterior wall of the superior and inferior vertebral bodies and measuring the translation of the superior vertebral body as a percentage of the distance between the two lines. This line is considered the displacement of vertebra over adjacent vertebra as numerator over the denominator which is length of the vertebral body below. Grades I and II are generally considered low-grade slip, whereas Grades III, IV, and V are considered high-grade slip (Koslosky & Gendelberg, 2020).

Lumbosacral angle (LSA)

The LSA angle was used to assess lumbar lordosis in lateral view. The angle produced by the superior surface of the sacrum and the horizontal surface is known as the LSA. LSA is normally between 40° and 45°. A higher LSA causes hyperlordosis, while a lower LSA causes flatback/hypolordosis (Okpala, 2014).

Statistical analysis:

The statistical analysis was carried out manually and with SPSS version 26.0 for Windows (SPSS Inc.,Chicago, IL, USA) of the statistics programme. The acquired data was statistically evaluated using descriptive statistics like mean, percentage, and standard deviation, p value calculation of direction of PIVD and lumbar alignment. Also, the descriptive statistics was used as bar diagrams, tables and percentages. The threshold for statistical significance was established at $p < 0.05$.

RESULTS

This cross sectional study was carried out among 102 participants with PIVD. According to statistical analysis the correlation between PIVD and lumbar vertebral alignment was seen.

Table1. Demographic variables

		Gender		Total (n)	No. of participants (%)
		Male	Female		
Age (Years)	30-35	13	11	24	22%
	36-40	3	8	11	12%
	41-45	7	12	19	19%
	46-50 yrs	18	30	48	47%
Occupation	Farmer	8	5	13	12.7%
	Homemaker	0	39	39	38.2%
	Desk job	14	7	21	20.6%
	Doctor	2	2	4	3.9%
	Dentist	4	2	6	5.9%
	Nurse	1	4	5	4.9%
	Construction	5	2	7	6.9%
	Driver	7	0	7	6.9%

Interpretation

The table 1 interpret that 47% of participants with PIVD were aged 46-50 years, with 39% being women and 18 men. The majority of the participants were housewives, with 38.2% being housewives. Other occupations included desk workers, farmers, construction workers, drivers, dentists, nurses, and doctors. The study also revealed that a significant number of participants were housewives, drivers, dentists, nurses, and doctors.

Table 2. Occurrence of level of PIVD

Level of PIVD	Number of participants
L1/2	0
L2/3	0
L3/4	6
L4/5	34
L5-S1	20
L2/3+ L3/4	3
L2/3+ L4/5	2
L2/3+ L5-S1	1
L3/4+ L4/5	9
L3/4+ L5-S1	2
L4/5+L5-S1	10
L1/2+L3/4+L4/5	1
L2/3+L3/4+L4/5	4
L2/3+L4/5+L5-S1	1
L3/4+L4/5+L5-S1	7
L1/2+L2/3+L3/4+L4/5	1
L1/2+L2/3+L3/4+L4/5+L5-S1	1

Interpretation

Table 2 depict that only 2.94% of 102 participants had Prolapsed Intracranial Disc Disease (PID) at the L1-2 level, compared to 68.62% at the L4-5 level, 41.2% at the L5-S1 level, 33.3% at the L3-4 level, 12.74% at the L2-3 level, and 41.2% at the L5-S1 level. Many people have PIVD on multiple levels, with 60 patients having a PIVD at a single level. The majority of PIVDs occurred at the L4/5 and L5-S1 levels in 10 participants and the L3/4 and L4/5 levels in 9 participants.

Interpretation

Table 3 interprets that prolapsed intervertebral discs were most common in the posterocentral and biforaminal directions in 46.07% of 102 individuals. Scoliosis was present in 33.33% of the participants, with 12 having convexity to the right and 22 having convexity to the left. Exaggerated lumbar lordosis was reported in 4 subjects, while decreased lordosis was seen in 66. Anterolisthesis was observed in 20.59% of the subjects, while retrolisthesis was observed in 11.

Table3. Distribution of direction of PIVD and lumbar alignment

Direction	Number of participants	Lumbar spinal alignment	Number of participants
Posterocentral	20	Scoliosis with convexity towards right (Grade I)	5
Biforaminal	30	Scoliosis with convexity towards left (Grade I)	13
Right paracentral	3	Flatback	32
Left paracentral	13	Hyperlordosis	3
Anterior	1	Anterolisthesis (Grade I)	6
		Anterolisthesis (Grade I)	4
Posterocentral+ Biforaminal	8	Retrolisthesis (Grade I)	0
Posterocentral + right paracentral	7	Scoliosis with convexity towards right (Grade I) + flatback	5
		Scoliosis with convexity towards right (Grade I) + flatback	1
Posterocentral + left paracentral	7	Scoliosis with convexity towards left (Grade I) + flatback	7
		Scoliosis with convexity towards left (Grade II) + flatback	2
Biforaminal + right paracentral	3	Flatback + anterolisthesis (Grade I)	8
		Flatback + anterolisthesis (Grade II)	1
		Flatback + anterolisthesis (Grade III)	1
Biforaminal + left paracentral	3	Flatback + retrolisthesis (Grade I)	10
Right paracentral + left paracentral	2	Scoliosis with convexity towards right (Grade I) + flatback + anterolisthesis (Grade I)	1
Posterocentral + biforaminal + right paracentral	1	Scoliosis with convexity towards right (Grade I) + hyperlordosis + anterolisthesis (Grade I)	1
Posterocentral + biforaminal + left paracentral	2	Scoliosis with convexity towards left (Grade I) + flatback + anterolisthesis (Grade I)	1
Posterocentral + right paracentral + left paracentral	2	Scoliosis with convexity towards left (Grade I) + flatback + retrolisthesis (Grade I)	1

Table 4. P value of correlation between direction of PIVD and the lumbar spinal alignment

Direction of PIVD / Spinal Alignment	Posterocentral	Biforaminal	Right Posterolateral	Left Posterolateral	Anterior
Scoliosis with convexity towards right	0.5521 (NS)	0.5599 (NS)	<0.0001***	0.0117*	0.7169 (NS)
Scoliosis with convexity towards left	0.1550 (NS)	0.0176*	0.8868 (NS)	<0.0001***	0.6025 (NS)
Flatback	0.9142 (NS)	<0.0001***	0.4538 (NS)	0.0946 (NS)	0.4629 (NS)
Hyperlordosis	0.8740 (NS)	0.3932 (NS)	0.7053 (NS)	0.8453 (NS)	0.8411 (NS)
Anterolisthesis	<0.0001***	0.0050**	0.7160 (NS)	0.0229*	0.0490*
Retrolisthesis	0.4986 (NS)	0.0014**	0.4356 (NS)	0.1197 (NS)	0.7300 (NS)

NS= not significant ; ***= extremely significant ; **= very significant ; *= significant

Interpretation

Table 4 shows that a significant correlation between the posterocentral direction of PIVD and anterolisthesis, biforaminal direction of PIVD and flatback, right paracentral direction of prolapse and scoliosis with convexity towards the right, and left

paracentral direction of prolapse and scoliosis with convexity towards the left (p<0.0001). The biforaminal direction of PIVD was found to be very significant for anterolisthesis and retrolisthesis (p=0.0050, 0.0014). However, the correlation between posterocentral direction of prolapse and scoliosis with convexity towards the right, biforaminal direction of prolapse and scoliosis with convexity towards the right, and anterior direction of prolapse and scoliosis with convexity towards right and left was not significant (p=0.5221, p=0.5599, p=0.7169, p=0.6025). The correlation between the biforaminal direction of PIVD and scoliosis with convexity towards the left was also significant (p=0.0176). The study highlights the importance of understanding the correlations between PIVD and various conditions.

Table 5. Lumbo-Sacral Angle (LSA) and pain

	Mean + SD
LSA	31.79 ± 11.02
Pain at Rest	1.99 ± 1.38
Pain on Activity	5.51 ± 1.66

Interpretation

Table 5 depicts the mean value of the lumbosacral angle was 31.79 with a standard deviation of 11.02. The pain assessment was carried out by using VAS scale during rest and during activity. The mean of pain on rest was 1.99±1.38 and during activity was 5.51±1.66.

DISCUSSION

The purpose of this study was to investigate and determine the relationship between PIVD and lumbar vertebral alignment. The study comprised 102 participants (61 women and 41 men), aged 30 to 55 years, who had undergone MRI and X-ray for the lumbosacral spine and had been diagnosed with PIVD and lumbar vertebral malalignment. According to Zhang et al. 2023, lumbar disc herniation most usually develops between the ages of 30 and 50. In his study, Fromayer stated that the average age of patients suffering from LDH and eventually undergoing surgery is 42 years (Zhang et. al., 2023). Brinjikji et al. (2015) conducted a systematic review of patients diagnosed with spinal degeneration in asymptomatic populations ranging in age from 20 to 80 years, concluding that imaging evidence of degenerative spine disease is common in asymptomatic individuals and increases with age (Brinjikji et. al., 2015). According to the findings of our study, the age group of 46 to 50 years, with 30 women and 18 males was found to be the most usually impacted, and around 39 females were housewives.

Despite what some studies claim, disc bulge is more commonly detected at the L4-5 and L5-S1 levels (Demirel et. al., 2017) Furthermore, approximately 70 patients in our study exhibited PIVD at the L4-5 level, while approximately 42 participants had PIVD at the L5-S1 level. Markku (1986) conducted a study with the goal of identifying risk groups and developing causal hypotheses, and concluded that in men, the risk of being hospitalised due to herniated lumbar disc or sciatica was lowest in professional and related occupations, significantly higher in all other groups, and highest among blue-collar workers in industry and motor vehicle drivers. The variation in risk between occupational groupings of women was less pronounced but remained noticeable. However, risk was strongly linked with self-assessed strenuousness of job in women but not in men (Heliovaara, 1987) According to the findings of our study, participants who were housewives or worked at a desk were the most likely to have PIVD.

In the year 2016, a systematic review of literature on risk factors for recurrent lumbar disc herniation was conducted with the goal of investigating the existing evidence on risk factors for recurrent LDH (rLDH). According to this study, smoking, disc protrusion, and diabetes were all predictors of rLDH. Due to the scarcity of literature, further data from high-quality observational studies is required to further study risk factors for Rldh (Huang et. al., 2016). A 2016 study titled "Lumbosacral morphology in lumbar disc herniation a chicken and egg issue" measured intervertebral disc angles (IDA), lumbar lordosis angle (LLA), lumbosacral lordosis angle (LSLA), lumbosacral angle (LSA), and sacral tilt (ST) on

lumbar magnetic resonance imaging. In addition, this study demonstrated no correlation between lumbosacral alignment and LDH, despite variations in IDA according to the grade and amount of disc herniation (Coskun et. al., 2016).

Another study conducted in 2018 called "Sagittal alignment of the lumbar spine" revealed that the correlation between lumbar lordosis and pelvic incidence is a major predictor of the pathophysiology of lumbar developmental and degenerative disease. Realignment goals in the spine compromised by degenerative disease or deformity must prioritise restoration of lumbo-pelvic parameters. The majority of lumbar lordosis occurs between L4 and S1, and restoring lordosis in the lower lumbar spine is especially crucial to avoid junctional failure and adjacent segment degeneration (Berven & Wadhwa, 2018). Okpala (2014) conducted study to determine the average value of this angle in our population. This study indicated that utilising the LSA, it is now possible to have an idea of the probable values at which to consider hypo-lordosis (below 15°)/hyper-lordosis (above 75°) in our community (Okpala, 2014). The findings of our investigation revealed that the mean value of LSA is 31.79±11.02.

In comparison with LDH without trunk shift and controls, LDH with coronal trunk shift has a more anterior shift of the C7 plumb line, less LL, and a more horizontal sacrum, according to Wu et al.'s 2019 study on the coronal and sagittal spinal alignment in lumbar disc herniation with scoliosis and trunk shift. In patients with disc herniation, correlation analysis revealed a discordant spinopelvic connection and a change in the compensatory model (Wu et. al., 2019) Our study's findings demonstrated that PIVD most frequently occurred in the posterocentral and biforaminal directions, each in 46.07% of subjects. The lumbar alignment also underwent numerous modifications, with 33.3% of participants having scoliosis and convexity to the left and right, 3.92% having hyperlordosis, 64.71% having hyperlordosis, 20.59% having anterolisthesis, and 10.8% having retrolisthesis. Additionally, the mean pain during activity was 5.51±1.66.and was 1.99±1.38 at rest.

With the rising frequency of lumbar disease among the working population as a result of long sitting and standing hours, there is also an increase in the financial burden placed on them as a result of costly studies. This leads to further delays in medical intervention and, as a result, a poor prognosis. A thorough physical examination must be combined with modern imaging to get an accurate diagnosis. Following a thorough postural examination, this study will allow the physical therapist to forecast the direction of the prolapsed disc in the lumbar segment. This study filled a knowledge gap by adding to the evidence that there is a considerable association between the direction of a prolapsed intervertebral disc and the alignment of the lumbar vertebrae.

This study has some limitations, including a small sample size and a dearth of male participants. It was limited to a single geographical area. The proposed time frame for the study was likewise rigorously adhered to. Data for lumbar spinal alignment with hyperlordosis and anterior orientation of prolapsed intervertebral disc were insufficient.

Clinical Implications

The relationship between PIVD orientation and vertebral alignment is crucial for patient management. It allows for treatment customization, enabling precise treatment plans based on the alignment of disc prolapses with vertebral misalignments. This knowledge also enhances prognostic capabilities, allowing for more informed treatment expectations and long-term management strategies. Additionally, it contributes to preventive medicine, identifying patterns indicating a predisposition for PIVD and specific vertebral alignments, enabling targeted interventions to reduce disc herniation risk. This study highlights the importance of thorough physical examination and modern imaging in diagnosing lumbar disease, especially in the working population.

Suggestions

Thorough research can be done by using validated measures such as the Roland-Morris Disability Questionnaire (RMDQ) and the Oswestry Disability Index (ODI) to standardise the assessment of functional disability, and enhance treatment outcomes. Tailored rehabilitation strategies can result from creative physiotherapy interventions that target specific PIVD directions and lumbar vertebral misalignments. By enabling people to take charge of their own spinal health, patient education and self-management techniques may be able to lessen the symptoms and recurrence of PIVD. Larger sample sizes and extended follow-up periods in longitudinal studies can shed light on the long-term effects of

physiotherapy treatments. Evidence-based guidelines for the management of spinal conditions related PIVD must be developed through collaborative research involving physiotherapists, radiologists, and biomechanical experts.

Conclusion

Prolapse was seen to occur on the same side as the convexity in cases with scoliosis. The posterocentral direction saw the most prolapsed discs in an anterolisthesis. Biforaminal prolapse was noticeably present in flatbacks. The prolpase in retrolisthesis was noticeably present in the biforaminal direction. The information for people with hyperlordosis and anterior prolapse is insufficient to make a comment. As a result, there was a significant relationship between lumbar vertebral alignment and the direction of PIVD.

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Conflict of İnterest

Authors declare no conflict of interest.

Ethics Statement

This research followed ethical standards and received approval from the Institutional Ethical Committee of Krishna Vishwa Vidyapeeth, KIMSDU dated 19/05/2023 and numbered 615/2022-2023.

Author Contributions

Study Design, PJ and SS; Data Collection, SJ; Statistical Analysis, SS; Data Interpretation, SJ and SS; Manuscript Preparation, PJ and SS; Literature Search, PJ, and SJ. All authors have read and agreed to the published version of the manuscript.

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