



Correlation between Clinical Features and Findings Observed on Magnetic Resonance Imaging in Patients with Lumbar Disc Prolapse

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

Editor(s):

(1) Dr. Parth Trivedi, Lecturer, C.M. Patel College of Physiotherapy, Civil Hospital Campus, Gujarat, India.

Reviewers:

(1) Luis Rafael Moscote-Salazar, Universidad de Cartagena, Colombia.

(2) Fábio Henrique Portella Corrêa de Oliveira, Universidade Federal Rural de Pernambuco, Brazil.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/53914>

Original Research Article

Received 15 November 2019

Accepted 17 January 2020

Published 24 January 2020

ABSTRACT

Background: Lumbar disc prolapse is one of the common causes of low back pain seen in active people. There are different reports regarding the clinical significance of various magnetic resonance imaging (MRI) findings observed in these patients. The study was conducted to correlate the clinical features and MRI abnormalities.

Methodology: This prospective study was carried out in department of Orthopaedics, in tertiary referral centre, for a year. Eighty six clinically diagnosed patients of lumbar disc prolapse were included in the study. They had a complete lumbar spine MRI with 3 tesla scanner. Clinical evaluation included pain distribution, neurological signs and symptoms. The MRI findings were then correlated with clinical signs and symptoms.

Results: This study included 86 patient, mean age 41years \pm 8.790, male to female ratio 1.2:1 and 49 patients (57%) were heavy workers. All patients presented with low back pain and radicular leg pain. Straight leg raising test was positive in 82.6% patients. 78 (90.7%) patients had neurological deficit (motor or sensory) and 28 patients had absent ankle reflex. There were 174 disc herniations, most common type being disc protrusion, position being centro-lateral and level being L4-L5 and L5-S1 (74.1%). There was statistically significant correlation between MRI findings of nerve root compression and SLRT (p-value = 0.035), absent ankle reflex (p-value <0.001) and neurological deficit (p-value = 0.019). There was no statistically significant correlation between type

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of disc herniation and neurological signs (p -value > 0.05). The clinical level at L4-L5 & L5-S1 and MRI level L4-L5 & L5-S1 had statistically significant correlation (p -value < 0.001).

Conclusion: Straight leg raising test (SLRT), neurological deficit and absent ankle reflex correlates well with nerve root compression visible in MRI; Clinical level and MRI level also correlates significantly. The type of disc herniation does not correlate with the neurological deficit.

Keywords: Magnetic resonance; lumbar disc prolapse; SLRT; low back pain.

1. INTRODUCTION

During the lifetime, 60-80% of adults can be likely to experience low back pain [1]. By the age of 30 years, almost half of adults have experienced an episode of low back pain [2]. Most symptoms are short lived, it is believed that 80-90% of episodes of low back pain resolve within 6 weeks of onset regardless of the treatment received [3]. Lumbar disc prolapse is one of the commonest causes of low back pain in active working population [4,5]. Around 95% of lumbar disc herniations occurs in L4-L5 and L5-S1 region [4]. A sedentary lifestyle, frequent driving, chronic cough, pregnancy, smoking and frequent lifting of heavy objects are considered risk factors [6,7]. The magnetic resonance imaging (MRI) have a noninvasive mechanism for viewing lumbar anatomy [4]. MRI can demonstrate morphological and pathological changes of the osteoligamentus and neural components of lumbar spine [8]. MRI is sensitive to disc conditions especially degenerative disc disease, extent of disc disease whether disc bulge, protrusion, extrusion or sequestration and its effects on cord / foramina compression [9]. Kim K Y et al. [10] found that the accuracy of MRI to predict the types of herniated lumbar intervertebral disc was 85%. A positive correlation has been noted between regression of lumbar disc herniations and resolution of symptoms and regression may be due to herniated tissue dehydration and immunological responses helping to resorb the disc material [11,12]. This study was conducted to determine the correlation between abnormalities visible in MRI and patients' clinical features including pain distribution, neurological signs, and symptoms in lumbar disc prolapse.

2. MATERIALS AND METHODS

A prospective observational study was conducted in the department of orthopaedics, tertiary referral centre for a period of one year. All the eligible patients who attended the department on having fulfilled the inclusion criteria and giving informed consent were taken for the study. It is

commenced after taking approval from institutional review board. Eighty six patients were enrolled in the study.

Hypothesis: Correlation exists between clinical features and magnetic resonance imaging findings in Lumbar Disc Prolapse.

Inclusion criteria: All the patients of age group 18-55 years with clinical diagnosis of lumbar disc prolapse were included in the study.

The clinical criteria used were:

- a. Low backache with radiation to the lower limb.
- b. Radicular pain along a specific dermatome.
- c. Nerve root tension signs like Pelvic list, straight leg raising test (SLRT), Cross-SLRT, Femoral stretch test.
- d. Presence of neurological symptoms and signs.

Three of four criteria had to be fulfilled for the diagnosis of lumbar disc prolapse. Patients with two positive criteria, when other causes were ruled out and MRI showed disc prolapse, were also included in the study.

Exclusion criteria:

1. Low back pain without radiculopathy.
2. Spine fracture.
3. Tumor, infectious or inflammatory disease
4. Cauda equina syndrome.
5. Case in which MRI is contraindicated (permanent pacemaker implanted/ claustrophobia).
6. Patient not giving informed consent.

The duration of symptoms, dermatomal level of pain distribution, neurological signs and symptoms were recorded.

These patients had a complete MRI evaluation at 3 tesla MR system. The slice were reported by a radiologist regarding disc degeneration, extent of disc prolapse, position of the herniated disc, neural foramen compromise, nerve root

compression and findings related to chronicity (facet joint arthritis, ligamentum flavum hypertrophy, canal stenosis, spondylolisthesis) and were recorded. While correlating clinical and MRI levels of lesion, if multiple level disc prolapse were present, the nerve root compression visible in MRI was used as the MRI level. When only neural foramen compression was seen, the conventional wisdom that L1-L2 level produces L2 dermatomal level symptoms, L2-L3 level produces L3 dermatomal level symptoms, L3-L4 level produces L4 dermatomal level symptoms, L4-L5 level produces L5 dermatomal level symptoms and L5-S1 level produces S1 dermatomal level symptoms was used. However, if only one-level neural foramen compression or neural compression was visible in MRI, the same was taken as the MRI level.

Disc Herniation classification was done as follows:

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

In disc protrusion and extrusion, the position of disc herniation was noted and its relationship with neural foramina and nerve root was recorded as Central, Centro-lateral and Far-lateral.

Neural canal compromise was graded as thecal sac compression, neural foramen/lateral recess compromise and nerve root impingement. The presence of findings related to chronicity (facet joint arthritis, ligament flavum hypertrophy, canal stenosis, spondylolisthesis), if any were recorded. Data was entered in Microsoft excel 2007 and statistical analysis done. For descriptive statistics; percentage, mean, standard deviation, median inter-quartile range, minimum, maximum were calculated along with tabular and graphical presentation were made. For inferential statistics; chi-square test was applied, the significant differences between the MRI findings and clinical observation was done

at 95% confidence interval where p-value less than 0.05 was considered statistically significant.

3. RESULTS

A prospective observational study carried out to determine the association between abnormalities visible in Magnetic Resonance Imaging (MRI) and clinical features of patients in lumbar disc prolapse. A total 86 cases fulfilling the inclusion criteria were enrolled in this study during study period of one year and following findings were obtained.

Out of 86 patients 47 (54.7%) were male and 39 (45.3%) were female. Age range was from 18 to 55 years, with mean age of 41 years \pm 8.790. When they are categorized in various age groups; most patients fall in 4th and 5th decade of life. Considering the lifestyle of the patients, 49 patients (57%) were heavy workers-most of them were male (76.6%) and 37 patients (43%) were light workers- most of them were female (66.7%). All the patients in the study presented with back pain. The average duration of back pain was 31.91 weeks \pm 26.829, minimum 4 weeks and maximum 104 weeks. Neurological symptoms were present in 73 patients (84.9%).

Out of 86 patients, 33 patients have right sided radiculopathy, 31 patients have left sided and 22 have bilateral radiculopathy. The pain distribution was also classified as per the dermatomal level where 17 patients have L5 level, 11 patients have S1 level, 30 patients have both L5 and S1 level, 8 patients have L4 L5 and S1 dermatomal level of distribution.

Lumbosacral spine tenderness was present in 39 patients. 14 patients have shown features of pelvic list. Straight leg raising test (SLRT) was positive in 71 patients (82.6%) and cross-SLRT was positive in 15 patients (17.4%). Femoral stretch test was positive in only 5 patients (5.8%).

Neurological deficits were present in 78 patients (90.7%). Out of them, 72 patients have motor weakness and 55 patients show sensory deficits. 27 patients (31.4%) have motor weakness of L5 (extensor hallucis longus) and 31 patients (36%) have motor weakness of S1 (flexor hallucis longus). Ankle jerk was absent in 28 patients (32.6%). After clinical evaluation, 47 patients were diagnosed to have prolapse at L4-L5 level, 34 patients at L5-S1 level, 3 patients L2-L3 level and 2 patients at L3-L4 level.

3.1 MRI Findings

Disc herniation: There were 174 disc herniation levels shown in 86 patients. Bulge was noticed in 75 levels (in 61 patients), protrusion was noticed in 93 levels (in 78 patients), extrusion was noticed in 6 levels (in 6 patients). The incidence of lumbar disc herniation was most commonly seen at L4-L5 level (43.7%) with 46 disc protrusion, 27 bulge and 3 extrusion; followed by L5-S1 level (30.5%) with 36 protrusion, 14 bulge and 3 extrusion and L3-L4 level (20.1%) with 27 bulge and 8 protrusion. Altogether herniation occurred in L4-L5 and L5-S1 in 74.1%.

Position of disc herniation: Out of 174 levels of disc herniation, the position of the protrusion (93 levels) and extrusion (6 levels) were specified in the MRI while the position of the disc bulge (75 levels) was not specified. Thus 99 different position of the disc herniation (protrusion and extrusion) were found. Out of them, 55 (55.6%) were centro-lateral disc herniation (50 protrusion and 5 extrusion), 42 (42.4%) were central (41 protrusion and 1 extrusion) and 2 (2%) were far-lateral (2 protrusion).

Neural foramen compromise: Out of 60 patients with neural foramen compromise due to disc herniation 61 different levels were noted. 28 patients had neural foramen compromise at L4-L5 level, 26 patients at L5-S1 level, 3 patients at L3-L4 level, 1 patient at L2-L3 level, 1 patient at L1-L2 level and 1 patient at both L4-L5 and L5-S1 level.

Nerve root compression: Out of 65 patients with nerve root compression, 67 different levels were noted. 32 patients had nerve root compression at L4-L5 level, 24 patients at L5-S1 level, 4 patients at L3-L4 level, 2 patients at L2-L3 level, 1 patient at L1-L2 level, 1 patient at L3-L4 and L5-S1 and 1 patient at L4-L5 and L5-S1 level.

MRI level: After MRI evaluation, MRI level of disc prolapse were 43 patients at L4-L5 level, 35 patients at L5-S1 level, 5 patients at L3-L4 level, 2 patients L2-L3 level and 1 patient at L1-L2 level.

Correlation of MRI findings and clinical observation: In 61 patients with disc bulge 54 had neurological deficit (kappa-value = -0.094, p-value = 0.261), in 78 patients with protrusion 72 had neurological deficit (kappa-value = 0.173, p-value = 0.160) and in 6 patients with extrusion 6 had neurological deficit (kappa-value = 0.015, p-value = 0.546). Thus, the correlation between types of herniation and neurological deficit is statistically not significant.

Out of 60 patients with neural foramen compromise 55 had neurological deficit during clinical examination with kappa-value = 0.040, p-value = 0.456, which is statistically not significant (Table 2).

Out of 65 patients with nerve root compression 57 patients had Straight Leg Raising Test (SLRT) positive with kappa-value = 0.233, p-value = 0.035, which is statistically significant (Table 3).

Out of 65 patients with nerve root compression 62 had neurological deficit during examination with kappa-value = 0.243, p-value = 0.019, which is statistically significant (Table 3).

Out of 26 patients with MRI showing nerve root compression at L5-S1, 16 had absent ankle reflex with kappa-value = 0.407, p-value <0.001, which is statistically significant (Table 4).

Out of 43 patients with MRI level L4-L5, 41 patients had clinical level L4-L5 which is statistically significant (kappa-value = 0.814, p-value <0.001). (Table 5) And out of 35 patients with MRI level L5-S1, 32 clinical level L5-S1 which is statistically significant (kappa-value = 0.879, p-value <0.001) (Table 6).

Table 1. Correlation of type of herniation and neurological deficit

Type of herniation		Neurological deficit n (%)		Total	Kappa-value	p-value	Remark
		Present	Absent				
Bulge	Present	54 (88.5)	7 (11.5)	61 (100.0)	-0.094	0.261	Not Significant (NS)
	Absent	24 (96.0)	1 (4)	25 (100.0)			
Protrusion	Present	72 (92.3)	6 (7.7)	78 (100.0)	0.173	0.160	NS
	Absent	6 (75.0)	2 (25.0)	8 (100.0)			
Extrusion	Present	6 (100.0)	0 (0.0)	6 (100.0)	0.015	0.546	NS
	Absent	72 (90.0)	8 (10.0)	80 (100.0)			
Total		78 (90.7)	8 (9.3)	86 (100.0)			

Table 2. Correlation of neural foramen compromise and neurological deficit

Clinical observation	Neural foramen compromise n (%)		Total	Kappa-value	p-value	Remark	
	Present	Absent					
Neurological deficit	Present	55 (70.5)	23 (29.5)	78 (100.0)	0.040	0.456	NS
	Absent	5 (62.5)	3 (37.5)				
Total		60 (69.8)	26(30.2)	86 (100.0)			

NS = Not Significant

Table 3. Correlation of nerve root compression and clinical observation

Clinical observation	Nerve root compression n (%)		Total	Kappa-value	p-value	Remark	
	Present	Absent					
SLRT	Positive	57 (80.3)	14 (19.7)	71 (100.0)	0.233	0.035	SN
	Negative	8 (53.3)	7 (46.7)				
Neurological deficit	Present	62 (79.5)	16 (20.5)	78 (100.0)	0.243	0.019	SN
	Absent	3 (37.5)	5 (62.5)				
Total		65 (75.6)	21 (24.4)	86 (100.0)			

SN = Significant

Table 4. Correlation of nerve root compression at L5-S1 and absent ankle reflex

Clinical observation	Nerve root compression at L5-S1 n (%)		Total	Kappa-value	p-value	Remark	
	Present	Absent					
ankle reflex	Absent	16 (57.1)	12 (42.9)	28 (100.0)	0.407	<0.001	SN
	Present	10 (17.2)	48 (82.8)				
Total		26 (30.2)	60 (69.8)	86 (100.0)			

SN = Significant

Table 5. Correlation between MRI level L4-L5 and Clinical level L4-L5

Clinical observation	MRI level L4-L5 n (%)		Total	Kappa-value	p-value	Remark	
	Present	Absent					
Clinical level L4-L5	Present	41 (87.2)	6 (12.8)	47 (100.0)	0.814	<0.001	SN
	Absent	2 (5.1)	37 (94.9)				
Total		43 (50.0)	43 (50.0)	86 (100.0)			

SN= Significant

Table 6. Correlation between MRI level L5-S1 and clinical level L5-S1

Clinical observation	MRI level L5-S1 n (%)		Total	Kappa-value	p-value	Remark	
	Present	Absent					
Clinical level L5-S1	Present	32 (94.1)	2 (5.9)	34 (100.0)	0.879	<0.001	significant
	Absent	3 (5.8)	49 (94.2)				
Total		35 (40.7)	51 (59.3)	86 (100.0)			

4. DISCUSSION

There are very few studies conducted to determine correlation between patients' clinical features including pain distribution, neurological

signs and symptoms in lumbar disc prolapse and abnormalities visible in MRI. In this study, the mean age of the patient was 41 ± 8.790 years. It is comparable to the study done by Shah LL et al. 104 which showed mean age to be 39 years

ranging from 16-65 years and another study done by Janardhana AP et al. [13] mean age was 44.83 years ranging from 20-72 years. In this study, 47 (54.7%) were male and 39 (45.3%) were female. This is similar to other studies [14].

In this study, 49 patients (57%) were heavy workers and 37 patients (43%) were light workers. All the patients presented with back pain. The average duration of back pain was 31.91 weeks \pm 26.829. This is similar to study done by Thapa SS et al. [15] 98 where 57 (100%) patient presented with back pain with average duration 30.54 \pm 27.043 weeks, which is similar to our study. Straight Leg Raising Test (SLRT) was positive in 71 patients (82.6%). Thapa SS et al. [15] 98 showed SLRT positive in 87.7% of cases. In this study, 71 patients had positive SLRT among them 57 patients had nerve root compression in MRI which is statistically significant (kappa-value = 0.233, p-value = 0.035). In this study, 78 patients (90.7%) had neurological deficits. Out of them, 72 patients had motor weakness and 55 patients show sensory deficits. 27 patients (31.4%) had motor weakness of L5; 31 patients (36%) had motor weakness of S1 and 8 patients (9.3%) had motor weakness of both L5 and S1 whereas 13 patients (15.1%) had sensory deficit of L5, 19 patients (22.1%) had sensory deficit of S1 and 18 patients (20.9%) had sensory deficit of both L5 and S1. In this study, ankle jerk was absent in 28 patients among them 16 had MRI findings of S1 nerve root compression which is statistically significant (kappa-value = 0.407, p-value= $<$ 0.001) which is similar to study done by Jhavar BS et al. [16]. where the positive predictive value of ankle jerk for PIVD at L5-S1 level was 67-84% and negative predictive value was 79-84%. In this study, 174 disc herniation levels were shown in 86 patients. Bulge was noticed in 75 levels (in 61 patients), protrusion was noticed in 93 levels (in 78 patients) and extrusion was noticed in 6 levels (in 6 patients). The study [15] shows that commonly involved level of lumbar disc prolapse is L4-L5 which is similar with our study. In this study, there were 174 levels of disc herniation; the position of the protrusion (93 levels) and extrusion (6 levels) were specified in the MRI while the position of the disc bulge (75 levels) was not specified. Thus 99 different position of the disc herniation (protrusion and extrusion) were found. Out of them, 55 (55.6%) were Centro-lateral disc herniation (50 protrusion and 5 extrusion), 42 (42.4%) were central (41 protrusion and 1

extrusion), and 2 (2%) were far-lateral (2 protrusion) which is similar to study by Thapa SS et al., [14] out of 73 positions of disc herniation 47 (65.3%) were Centro-lateral, 25 (33.3%) were central and 1 (1.4%) was far-lateral, which is similar to our study. This is because disc is covered by the thin posterior longitudinal ligament, which is concentrated in the midline, from which small bands extend laterally to cover the inferior aspect of the disc. In this study; out of 61 patients with disc bulge 54 had neurological deficit (kappa-value = -0.094, p-value = 0.261), out of 78 patients with protrusion 72 had neurological deficit (kappa-value = 0.173, p-value=0.160) and all 6 extrusions had neurological deficit (kappa-value = 0.015, p-value=0.546). Thus the correlation between types of herniation and neurological deficit is not statistically significant. This is similar to the study done by Janardhana AP et al. [13] who concluded that type of disc herniation (bulge, protrusion or extrusion) correlates poorly with clinical signs and symptoms. Out of 60 patients with neural foramen compromise 55 had neurological deficit during clinical examination which is not statistically significant (kappa-value = 0.040, p-value=0.456). But, out of 65 patients with nerve root compression, 62 had neurological deficit during examination which is statistically significant (kappa-value = 0.243, p-value=0.019). In this study, out of 43 patients with MRI level L4-L5, 41 patients had clinical level L4-L5 which is statistically significant (kappa-value = 0.814, p-value $<$ 0.001) and out of 35 patients with MRI level L5-S1, 32 patients had clinical level L5-S1 which is also statistically significant (kappa-value = 0.879, p-value $<$ 0.001); which is similar to study done by Janardhana AP et al. [13] who found strong correlation between clinical level and MRI level.

The small population is a marked drawback of this study. During the given period of the study 86 patients were enrolled in the study. A large sample would have yield a more reliable result. Only those patients with clinical diagnosis of lumbar disc prolapse and could afford to undergo MRI of lumbar spine were included in this study. The MRI reporting was done by different radiologists which might have lead to inter-observer variations which is a drawback of the study.

5. CONCLUSION

To conclude, clinical findings correlate well with MRI findings, but all MRI abnormalities need not

have a clinical significance. Straight leg raising test (SLRT), neurological deficit and absent ankle reflex correlates well with nerve root compression visible in MRI; Clinical level and MRI level also correlates significantly. The type of disc herniation does not correlate with the neurological deficit. Thus, it is the combination and correlation of the clinical examination findings and MRI findings that is essential for successful selection of patients for surgical management of sciatica. If a herniation seen on MRI is not likely to be responsible for the patients symptoms then is not reasonable to expect that surgical removal or other treatment aimed at that disc will be beneficial to the patient. Even when surgical intervention is not being considered it is important for clinicians to know how accurately clinical findings can clinicians confidently provide patients with a clear explanation of the source of leg pain including the level of herniated disc.

CONSENT AND ETHICAL APPROVAL

As per international standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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