ORIGINAL ARTICLE https://doi.org/10.3126/njr.v12i1.42211

Evaluation of the Diagnostic Utility of Spinal Magnetic Resonance Imaging in Low Back Pain Patients

Sharma BR[1], Singh S[2], Timilsina MM[3]

[1]Associtate Professor, Department of Radiology, [2]Associtate Professor/B.Sc. MIT Program Coordinator, Gandaki Medical College and Teaching Hospital,[3]Medical officer, Urban health Promotion Centre, Pokhara, Nepal

Received: March 7, 2022 **Accepted:** April 1, 2022 **Published:** June 30, 2022

Cite this paper:
Sharma BR, Singh S, Timilsina MM. Evaluation of the diagnostic utility of spinal magnetic resonance imaging in low back pain patients. *Nepalese Journal of Radiology*. 2022;12(1):30-38. https://doi.org/10.3126/njr.v12i1.42211

ABSTRACT

Introduction:

Low back pain secondary to degenerative disc disease is a condition that affects young to middle-aged persons with peak incidence at approximately 30-39 years. Magnetic Resonance Imaging (MRI) is the standard modality for detecting disc pathology. This study is being conducted to review the pattern of spinal degenerative diseases in patients referred to our institution.

Methods:

A retrospective study was conducted at Gandaki Medical College Teaching Hospital & Research Centre (GMCTHRC) from January 2018 to April 2018 with approval from the Institutional Review Committee of Gandaki Medical College Teaching Hospital and Research Centre. The MRI findings were noted i.e. disc desiccation, disc bulge (diffuse, symmetrical and asymmetrical), disc protrusion, neural foramen narrowing, traversing nerve root compression, exiting nerve root compression and posterior annular ligament tear.

Results:

Out of 98 patients enrolled in the study mean age being 41 years. Disc bulge as most common finding seen in 89 (90.8%) followed by protrusion 50 (51.1%) neural foraminal narrowing (NFN) 72 (73.4%) traversing nerve roots (TNR) compression 58 (59.1%) and exiting nerve root (ENR) compression 22 (22.4%).

Conclusions:

The study shows that degenerative disc diseases remain the cause of morbidity in the most productive years of life (30-40 years). Large volumes of MRIs performed for this condition represent a significant economic and healthcare burden in a developing country like Nepal.

Keywords: *Intervertebral Disc Displacement;Intervertebral Disc Degeneration; Magnetic Resonance Imaging*

Correspondence to: Bhoj Raj Sharma
Department of Radiology
Gandaki Medical College, Pokhara.
Email: bhojrajsharma2@gmail.com

INTRODUCTION

Low back pain is defined as the pain below the costal margins and above the inferior gluteal fold, with or without radiculopathy and is called chronic if persists for three months or more.[1] The mechanical stress to the vertebra and intervening discs from age-related wear and tear remains the primary cause of degenerative process apart from acute stress. Sciatica pain occurs mostly on one side of the body. Mild tingling sensation, dull ache or burning sensation can aggravate standing, bending straining and walking. In severe cases, the patient becomes unable to move around.[1]

Lumbar disc prolapse is one of the commonest causes of low back pain in the working population. MRI is the gold standard non-invasive investigation for lumbar disc details.[2] Intervertebral disc degenerations are known to occur as a result of natural ageing under the influence of various environmental factors.[3-5] This study is being conducted to review the pattern of spinal degenerative diseases in patients referred to our institution.

METHODS

This was a cross-sectional, observational study done at the Department of Radiology, Gandaki Medical College. The duration of the study was four months from January 2018 to April 2018. A total of 98 patients of lumbar spine MRI conducted during that period, using Siemens magneto Essenza 1.5 MRI machine. Institutional review board Ethical approval was obtained. All the observations were done by five radiologists (associated professor and lecturer). Patients between the age of 19-93 years of the age with low back pain were included in the study. Patients with a history of trauma, prior surgery, spinal infections, active malignancy, whole spinal screening, additional pathology in the cervical and thoracic spine and except the above-mentioned age were excluded from the study. The normal MRI findings as well as abnormal MRI findings were noted as disc desiccation, disc bulge (diffuse, symmetrical and asymmetrical), disc protrusion, neural foramen narrowing, traversing nerve root compression, exiting nerve root compression and posterior annular ligament tear.

All the data are managed and kept in Microsoft excel 2019. According to the dependent and independent variables, data were analyzed using predictive analytics software (SPSS version 25 IBM corporation Chicago, IL USA). Descriptive statistics were expressed as a number, frequency, percentage of categorical variables and as mean median, and minimum-maximum for age variables.

RESULTS

A total of 98 MRIs of the lumbosacral spine were reviewed. The mean age of the sample was 41.3±15.163 years. There was slight female predominance with a female to male ratio of 1.2:1 (Figure-8, Table-4)

Disc desiccation was the commonest change in the disc, however, according to modified Pfirrmann grading of grades I-V.

Table 1: Different variables disc bulge, annular tear, and disc desiccation with grading at multiple lumbar disc level

Intervertebral disc level	Disc bulge	Annular tear	Disc desiccation Grade-I	Disc desiccation Grade-II	Disc desiccation Grade-III	Disc desiccation Grade-IV	Disc desiccation Grade-V
L1-L2	5 (5.1%)	----------	69 (70.4%)	16 (16.3%)	11 (11.2%)	2 (2%)	----------
L2-L3	18 (18.4%)	----------	98 (100%)	----------	----------	----------	----------
L3-L4	29 (29.6%)	----------	46 (46.9%)	8 (8.2%)	29 (29.6%)	12 (12.2%)	3 (3.1%)
L4-L5	63 (63.3%)	6 (6.1%)	22 (22.4%)	4 (5.1%)	26 (26.5%)	37 (37.8%)	8 (8.2%)
L5-S1	52 (53.1%)	4 (4.1%)	25 (25.5%)	8 (8.2%)	20 (20.4%)	24 (24.5%)	21 (21.4%)

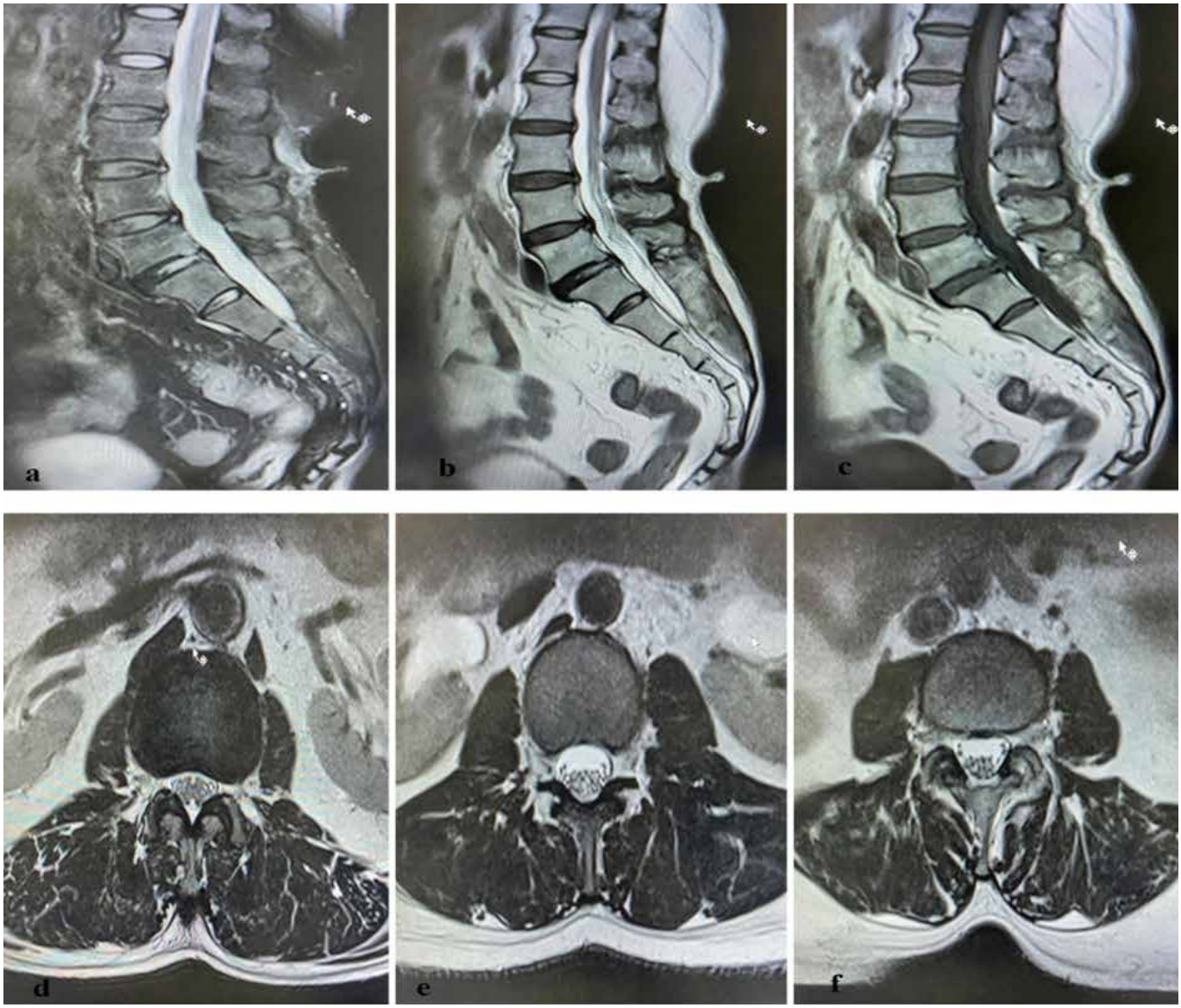

Figure 1: All normal MRI images of lumbar spine sagittal and lumbar spine except areas of disc desiccation, **a**- FLAIR (fluid-attenuated inversion recovery sequence), **b**-T2 weighted images**, c**-T1 weighted image, **d, e, f**- T2 weighted axial images

Disc desiccation of grade I is maximum at L1-L2, L2-L3, and L3-L4 levels while grade III/IV at L4-L5 and L5-S1 levels. (Figure-2, Table-1)

Posterior annular ligament tear was predominantly at L4-L5 level and L5-S1 level 6(6.1%) and 4(4.1%) respectively, while there was no posterior annular tear in other cases. (Figure-3, Table1)

Disc bulge was the most commonest type of disc herniation which accounted to be 67% and disc protrusion accounted for 58% of the study population. Disc extrusion and disc sequestration were not seen in the selected duration of the study. (Figure-4, Table-1)

Similarly, there was disc protrusion at multiple levels. Disc protrusion was classified per the standard guideline as central, sub-articular (right or left), foraminal (right or left) and extraforaminal (right/left). There were no cases of disc protrusion at the L2-L3 level in our study, however, the maximum number of cases with disc protrusion was at L4-L5 and L5-S1 levels.(Figure-5,6, Table-2)

The neural foramen narrowing was seen at all levels, however, more commonly involved in L4-L5 and L5-S1 levels. (Figure-5, 7, Table-3)

The traversing nerve roots compression is also seen at multiple levels, however, in this study, no cases are seen at the L1-L2 level. At L2-L3, and L3-L4 levels there were few cases, mild cases in L4-L5 and moderate cases at the L5-S1 level (Figure-6, Table-3)

Similarly exiting nerve root compression is seen at the L3-S1 level, with no cases at L1-L2 and L2-L3 levels and few cases at L3-L4, L4-L5, L5-S1. (Figure-6, Table-3)

Table 2: Different variables disc protrusion with their subtypes at multiple lumbar disc levels

Inter-vertebral disc level	Disc protrusion central	Disc protrusion Rt. Sub Articular	Disc protrusion Lt. Sub Articular	Bilateral sub articular disc protrusion	Disc protrusion Rt. Foraminal	Disc protrusion Lt. Foraminal	Bilateral sub articular disc protrusion
L1-L2	----------	----------	----------	----------	1 (1%)	----------	----------
L2-L3	----------	----------	----------	----------	----------	----------	----------
L3-L4	2 (2%)	1 (1%)	----------	----------	----------	----------	----------
L4-L5	23 (23.5%)	25 (25.5%)	----------	----------	----------	----------	----------
L5-S1	23 (23.5%)	25 (25.5%)	4 (4.1%)	----------	----------	----------	----------

Table 3: Different variables neural foramen narrowing, traversing nerve root compression, exiting nerve root compression at multiple lumbar disc levels

Inter-vertebral disc level	Neural foramen narrowing		Bilateral neural foramen narrowing	Traversing nerve root compression		Bilateral traversing nerve root compression	Exiting nerve root compression		Bilateral exiting nerve root compression
	Right	Left		Right	Left		Right	Left	
L1-L2	3 (3.1%)	3 (3.1%)	3 (3.1%)	----------	----------	----------	--------	--------	----------
L2-L3	7 (7.1%)	7 (7.1%)	7 (7.1%)	3 (3.0%)	2 (1.9%)	2 (1.9%))	0 (0%)	0 (0%)	0 (0%)
L3-L4	14 (14.3%)	11 (11.2%)	11 (11.2%)	5 (4.9%)	4 (4.0%)	4 (4.0%)	1 (1%)	0 (0%)	0 (0%)
L4-L5	40 (40.8%)	41 (41.8%)	35 (35.7%)	18(18.3%)	17 (16.6%)	9 (9.1%)	7 (7.1%)	4 (4.0%)	4 (4.0%)
L5-S1	33 (33.3%)	37 (37.8%)	26 (26.5%)	25 (24.5%)	27 (26.4%)	20 (19.6%)	3 (3.0%)	13(13.2%)	1 (1%)

Table 4: Age distribution and its frequency

Age	Frequency	Percentage
10-19	1	1
20-19	23	22.4
30-39	26	26.5
40-49	21	21.4
50-59	16	16.3
60-69	7	7.1
70 and above	5	5.1
Total	98	1000.0

Figure 2: T2 weighted mid Sagittal image of lumbar spine showing disc desiccation at multiple levels with bulge and protrusion

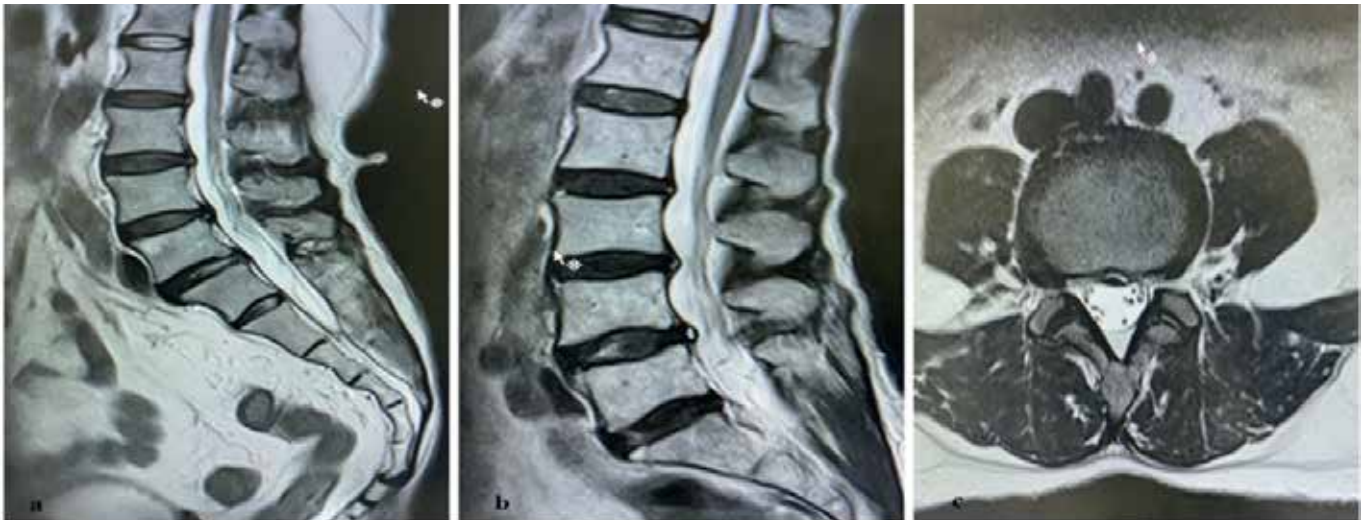

Figure 3: T2 weighted sequence sagittal (**a & b**) and axial **(c)** images. **a**-T2 weighted mid sagittal image showing disc protrusion at multiple levels with posterior annular tear at L3-L4 level, **b**-T2 weighted mid sagittal image showing disc protrusion at multiple levels with posterior annular tear at L2-L3, L3-L4 and L4-L5, **c**- T2 weighted axial image showing posterior annular tear and central protrusion at L4-L5 level

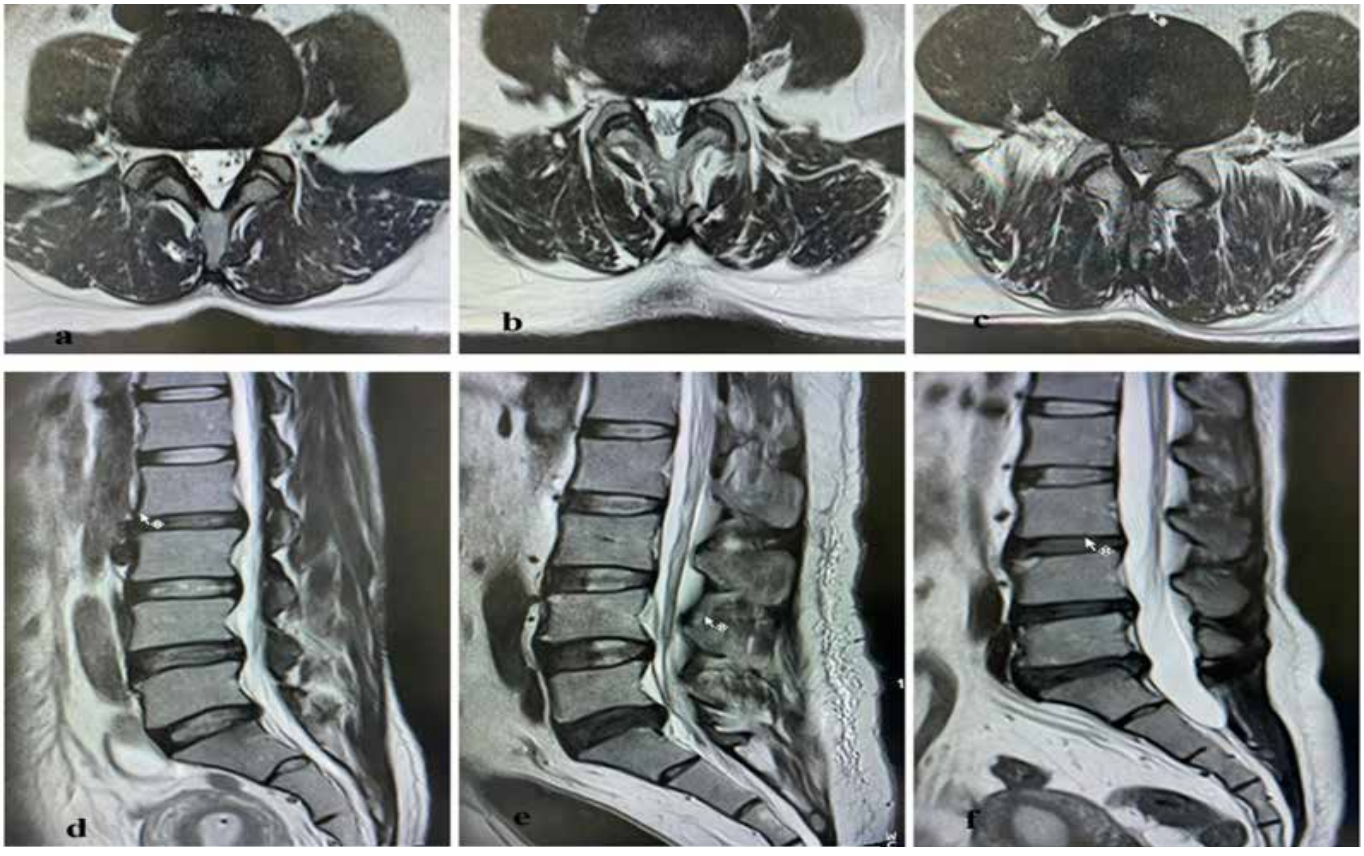

Figure 4: T2 weighted sequences **a-f** (Axial a-c, sagittal d-f), **a** -T2 axial showing asymmetrical disc bulge with bilateral neural foramen narrowing and compression of traversing nerve roots at L4-l5 level, **b**-T2 axial showing symmetrical disc bulge with bilateral neural foramen narrowing at L4-L5 level, **c**-T2 weighted image showing diffuse symmetrical disc bulge with causing bilateral neural foramen narrowing and compression of traversing nerve roots at L5-S1 level, **d**-T2 mid sagittal image showing disc bulge at multiple levels L2-S1, **e**-T2 mid sagittal image showing disc bulge with protrusion at L5-S1 level, **f**-T2 Mid sagittal image showing disc protrusion at L4-L5 and L5-S1 level

Figure 5: T2 weighted sequence axial (**a, b & c**) and sagittal (**d**) images. **a**-central protrusion causing bilateral traversing nerve root compression and left exiting nerve root compression at L5-S1 level, **b**-central, bilateral sub articular protrusion causing bilateral traversing and left exiting nerve root compression at L3-L4 level, **c**-central disc protrusion causing compression of left traversing nerve root at L5-S1 level, **d**- disc protrusion at L5-S1 level causing bony spinal canal narrowing

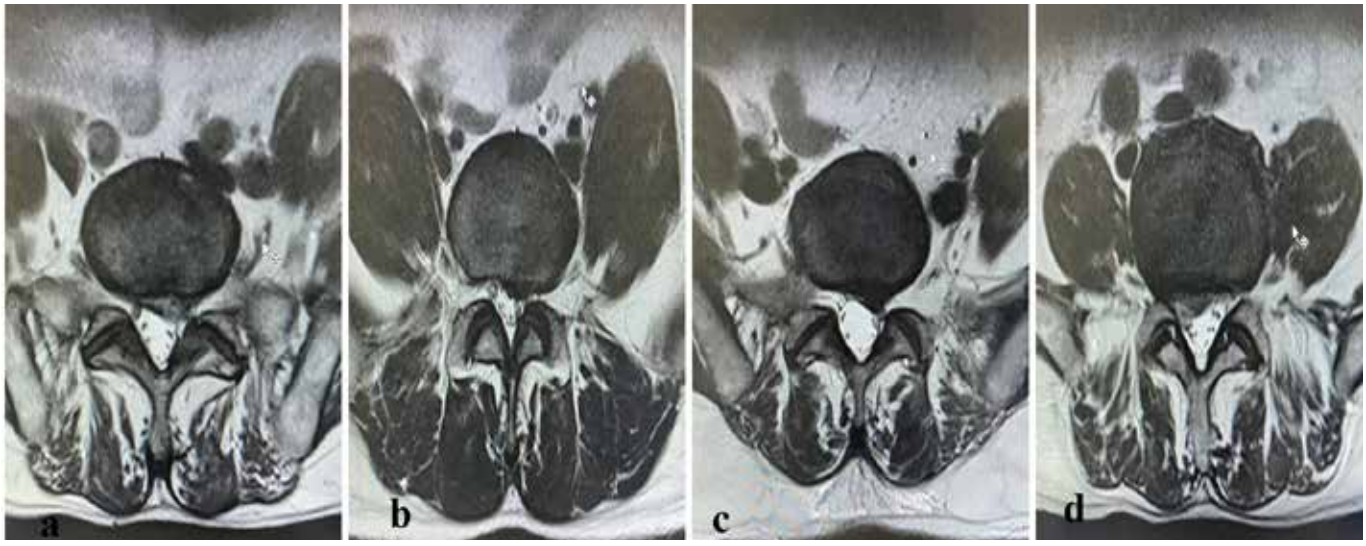

Figure 6: T2 weighted axial images showing subarticular protrusion causing compression of traversing and exiting nerve roots. **a, b & c**—Left sub articular protrusion at L5-S1 and L4-L5 level, **d**-Right sub articular protrusion at L5-S1 level

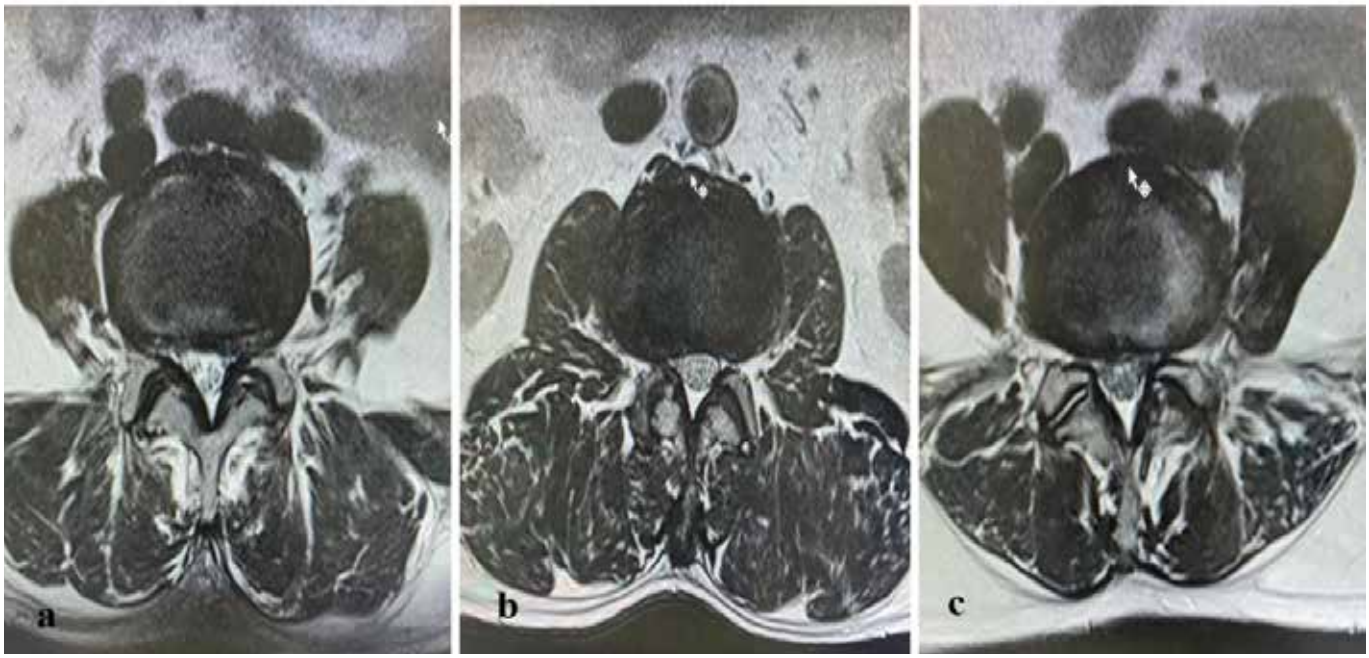

Figure7: T2 weighted axial images showing diffuse symmetrical and asymmetrical disc bulge causing bilateral neural foramen narrowing and compression of traversing nerve roots at L2-L3, L1-L2 levels

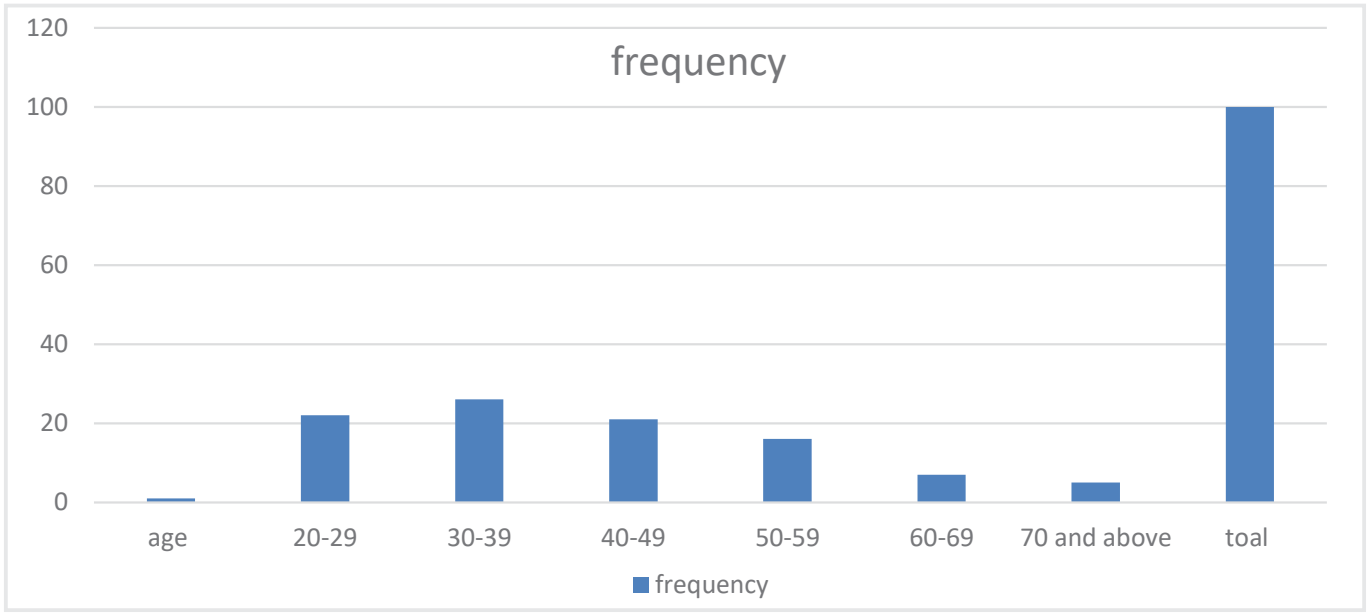

Figure 8: Bar graph showing frequency and its involvement according to age range

DISCUSSION

Lumbar disc degeneration is the most common cause of low back pain around the world and the majority is due to disc herniation and protrusion. After the development of MRI, non-invasive excellent imaging of the spine is possible. Men are more commonly affected by disc degeneration than women. It is most likely due to the increased mechanical stress and injury.[6]

The most common disc degeneration was observed in the second decade of life in our study, which was comparable with other study.[7] Disc desiccation is a

common degenerative change of the intervertebral disc.

Among the degenerative changes, disc desiccation was seen in 67%of patients, followed by disc bulge 67% and disc protrusion 58%, Similar pattern of degenerative changes was noted in a study conducted by Jensen et al.[8] However, Biluts et al.found disc prolapse (70.1%) commoner than disc bulge (18.5%).[9] Weishaupt et al. also found similar findings with disc prolapse slightly more common than disc protrusion, the latter increased with increasing age.[10]

Disc degeneration with diffuse disc changes and protrusion was commonly found at L4-L5 and L5-S1 levels and L1-L2 was the least common. Findings are consistent with the studies conducted by Weishaupt et al. and Verma et al.,West et al. and Biluts et al.[9-13] Multiplicity in the disc level involvement are common as compared to the single-disc involvement which is similar to the nerve root, traversing nerve roots compression is also similar with previous studies.14-15 There was a pattern of craniocaudal direction pattern of disc herniation.

CONCLUSION

Lumbar disc degeneration is the most common cause of low back pain. Men are more commonly affected by degeneration than women. Multiple levels of disc involvement are seen. Posterior annular tear, disc desiccation, bulge, protrusion, nerve root compression and traversing nerve root compression was more at L4-L5 and L5-S1 disc level and least at L1-L2 level as stated above.

MRI is the standard imaging modality for the detection of disc pathology due to its advantage over multiplanar imaging capability, an excellent spatial resolution of spinal soft tissue and no radiation.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

REFERENCES

1. Chou R. Low back pain (chronic). BMJ Clin Evid. 2010;2010:1116.
2. Postacchini F. Management of herniation of the lumbar disc. *J Bone Joint Surg Br*. 1999;81(4):567–76. http://dx.doi.org/10.1302/0301-620x.81b4.10213
3. Janardhana AP, Rajagopal, Rao S, Kamath A. Correlation between clinical features and magnetic resonance imaging findings in lumbar disc prolapse. *Indian J Orthop*. 2010;44(3):263–9. http://dx.doi.org/10.4103/0019-5413.65148
4. Dagi TF, Tarkington MA, Leech JJ. Tandem lumbar and cervical spinal stenosis. Natural history, prognostic indices, and results after surgical decompression: Natural history, prognostic indices, and results after surgical decompression. *J Neurosurg*. 1987;66(6):842–9. http://dx.doi.org/10.3171/jns.1987.66.6.0842
5. Gore DR, Sepic SB, Gardner GM. Roentgenographic findings of the cervical spine in asymptomatic people. *Spine* (Phila Pa 1976). 1986;11(6):521–4. http://dx.doi.org/10.1097/00007632-198607000-00003
6. Gore DR. Roentgenographic findings in the cervical spine in asymptomatic persons: A ten-year follow-up. *Spine* (Phila Pa 1976). 2001;26(22):2463–6. http://dx.doi.org/10.1097/00007632-200111150-00013
7. Cheung KMC, Karppinen J, Chan D, et al. Prevalence and pattern of lumbar magnetic resonance imaging changes in a population study of one thousand forty-three individuals. *Spine* (Phila Pa 1976). 2009;34(9):934–40. http://dx.doi.org/10.1097/BRS.0b013e3181a01b3f
8. Jensen MC, Brant-Zawadzki MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic resonance imaging of the lumbar spine in people without back pain. *N Engl J Med*. 1994;331(2):69–73. http://dx.doi.org/10.1056/NEJM199407143310201
9. Biluts H, Munie T, Abebe M. Review of lumbar disc diseases at TikurAnbessa Hospital. Ethiop Med J. 2012;50(1):57-65.

10. Weishaupt D, Zanetti M, Hodler J, Boos N. MR imaging of the lumbar spine: prevalence of intervertebral disk extrusion and sequestration, nerve root compression, end plate abnormalities, and osteoarthritis of the facet joints in asymptomatic volunteers. *Radiology*. 1998;209(3):661–6. http://dx.doi.org/10.1148/radiology.209.3.9844656

11. S Verma PG, A Mushi, P Goyal, S Verma, V Sardana.A retrospective analysis of magnetic resonance imaging findings in 20 -40 year old patients with low back pain. Experience at A semi urban tertiary healthcare centre in northern India. *Internet j spine surg*. 2011;6(1). http://dx.doi.org/10.5580/1db8

12. West W, West KP, Younger EN, Cornwall D. Degenerative disc disease of the lumbar spine on MRI. West Indian Medical J. 2010;59(2):192-5.

13. Takatalo J, Karppinen J, Niinimäki J, et al. Prevalence of degenerative imaging findings in lumbar magnetic resonance imaging among young adults. *Spine* (Phila Pa 1976). 2009;34(16):1716–21. http://dx.doi.org/10.1097/BRS.0b013e3181ac5fec