Original Research Article

Role of MRI in identification, characterization and assessing the sequelae of lumbar disc degenerative changes

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Abstract

Background: Low back pain is a common problem encountered by most people now a days. The most important cause of low back pain is the lumbar disc degenerative changes. MRI is the standard imaging modality for the identification of disc lesions. **Aims and objectives:** To identify, evaluate and characterize the changes associated with lumbar disc degenerative disease and to assess the sequelae of lumbar disc degeneration. **Study design:** Observational study. **Materials and Methods:** An observational study is conducted on 100 patients with in a time period of three months. All patients irrespective of age and sex with chief complaints of low back pain referred to the department of radiology are included in the study. Those patients who presented with low back pain but with history of trauma, infections, congenital lesions and tumor conditions of lumbar spine are excluded from the study. All patients included in the study are subjected to MRI scanning using 1.5 Tesla Siemens Magnetom Essenza unit. After ruling out contraindications for MRI, the scanning is done using the following sequences. T1W axial, T1W sagittal, T2W axial, T2W sagittal, STIR axial and Coronal. MRI findings such as disc bulge, Schmorl's nodes, Disc herniation, Annular tears and spinal canal stenosis have been observed and characterized. **Results:** It is observed that lumbar disc degenerative changes are more common in males compared to females. The most common age group involved is between 41-50 years. Multiple levels of disc involvement is seen rather than single disc in most patients. These findings are comparable with other studies. The most commonly affected disc is L4-L5 intervertebral disc. Disc bulge, Disc herniation, Annular tears and Spinal canal stenosis is more common at L4-L5 and L5-S1 levels and least common at L1-L2 level. **Conclusion:** MRI plays a pivotal role in precise localization of intervertebral disc changes. Because of its multi-planar image acquisition capability, excellent soft tissue contrast and lack of radiation exposure it turned out to be a standard imaging modality for localizing and characterizing disc pathology.

Key Words: Disc degeneration, Low back pain, MRI, Schmorl's nodes, spinal canal stenosis.

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INTRODUCTION

Low back pain is the most common problem experienced by young to middle aged people now a days. The most common cause being the lumbar disc degenerative disease. There are many risk factors associated with lumbar disc degenerative disease like advancing age, smoking, Obesity, heavy-weight lifting, genetic and hereditary factors[1] The main purpose of conducting this study is to identify, evaluate and assess the sequelae of lumbar disc degenerative changes using MRI as the imaging modality. The purpose of using MRI is because of its advantage of lack of radiation, multi-planar imaging capability, an excellent soft tissue contrast and precise localization of intervertebral disc changes.[2,3]

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MATERIALS AND METHODS

This is an observational study conducted on 100 patients. The duration of study is for 3 months ie from 1st April 2017 to 1st August 2017.

Inclusion Criteria: All patients irrespective of age and sex with chief complaints of low back pain referred to the department of radiology are included in the study.

Exclusion Criteria

1. Those patients who presented with low back pain but with history of trauma, infections, congenital lesions and tumor conditions of lumbar spine are excluded from the study.
2. Patients with metallic implants, cardiac pacemakers and claustrophobic patients are excluded from the study.

Ethical committee clearance is taken before the start of the study. All patients included in the study are subjected to MRI scanning using 1.5 Tesla Siemens MagnetomEssenza unit. After ruling out contraindications for MRI, the scanning is done using the following sequences. T1W axial, T1W sagittal, T2W axial, T2W sagittal, STIR axial and Coronal. MRI findings such as loss of central high T2 signal on MRI, Disc bulge, Schmorl's nodes, Disc herniation, Annular tears and Spinal canal stenosis have been observed and characterized.

Loss of central High T2 signal on MRI: The most common degenerative change noted on MRI is loss of central high signal intensity of the disc on T2W images. In a normal intervertebral disc, the nucleus pulposus appears hyper-intense and annulus fibrosus has low signal on T2WI. This is mainly because of high water content in a normal disc. Loss of high T2 signal is the most common degenerative change noted. (Fig. 1)

Disc bulge: It is identified as the presence of disc tissue circumferentially beyond the edges of vertebral ring apophysis and is not considered herniation[8]. (Fig. 3a; 3b)

Schmorl's node: It is identified as a herniated disc in cranio-caudal direction through a break in vertebral body end plate[8]. (Fig. 2)

Disc Herniation: It is identified as the localized displacement of disc material beyond the limits of intervertebral disc space. A disc space is defined craniad and caudad by the vertebral body end plates and peripherally by the outer edges of vertebral ring apophyses[8]. Herniated disc s may take the form of Protrusion, Extrusion and Sequestration.

Disc Protrusion: It is identified if the greatest distance between the edges of the disc material beyond disc space is less than the distance between the edges of the base[8]. (Fig. 4a; 4b)

Disc Extrusion: It is identified if the edges of the disc material beyond the disc space is greater than the distance between edges of the base[8]. (Fig. 5a; 5b)

Disc sequestration: It is identified if the displaced disc material has no continuity with the parent disc[8]. (Fig. 6a; 6b)

Annular fissure: they are localized radial, horizontal or concentric disruption of annulus without displacement of disc material beyond the limits of intervertebral disc space[8]. A tear in the disc is identified on MRI as T2 hyper-intensity in the annulus. (Fig. 7a; 7b)

Spinal Canal Stenosis: This is seen as an obliteration of anterior CSF space. Lateral recess narrowing was identified on T2W axial images. Lateral recess is a space bounded laterally by pedicle, dorsally by superior articular facet, ventrally by posterior surface of vertebral body and medially it is open to spinal canal[9]. Neural foraminal stenosis identified on T2W sagittal image by identifying any compression of neural foramen by Facetalarthropathy, osteophytes and ligamentum flavum thickening. (Fig. 8a; 8b; 8c).

RESULTS

Figure 1:

Figure 2:

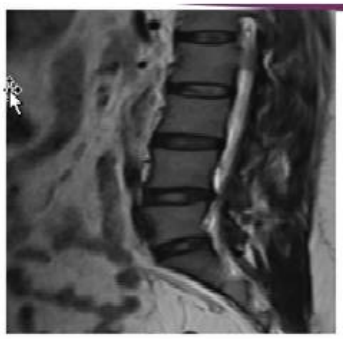

Figure 3a:

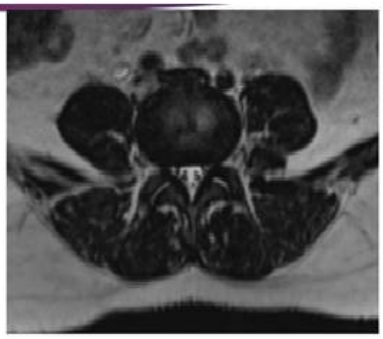

Figure 3b:

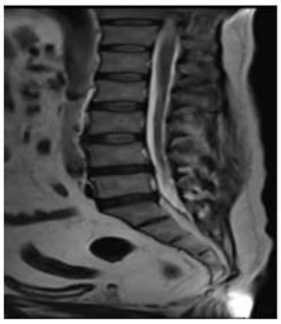

Figure 4a

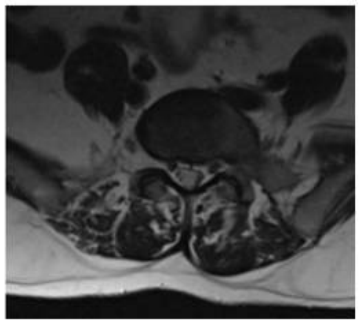

Figure 4b

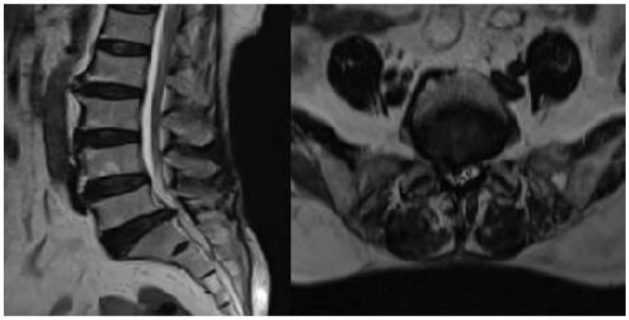

Figure 5a

Figure 5b

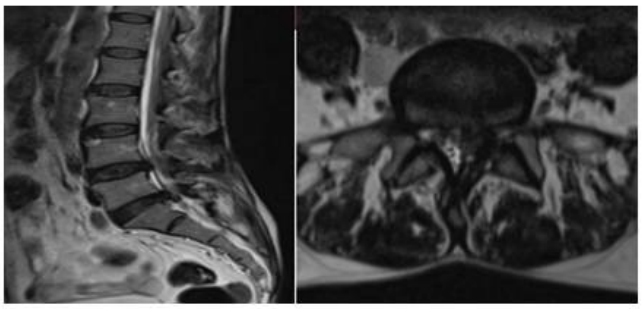

Figure 6a

Figure 6b

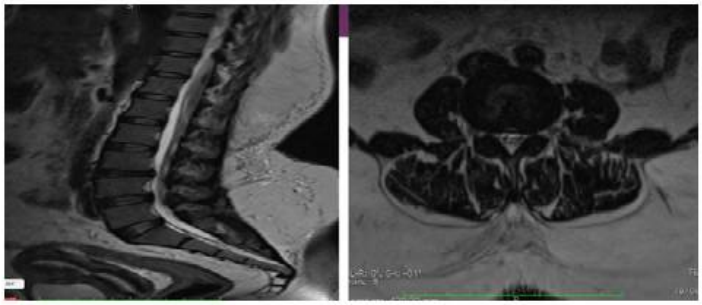

Figure 7a

Figure 7b

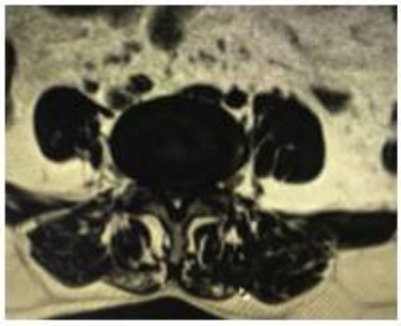

Figure 8a

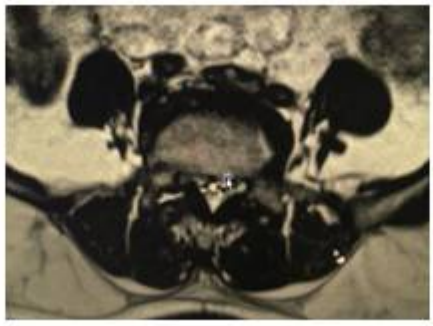

Figure 8b

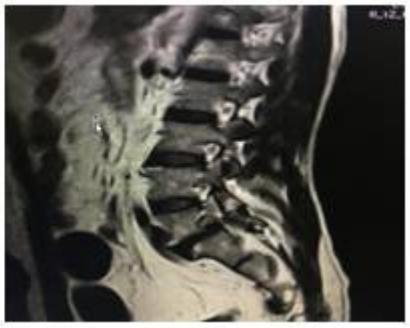

Figure 8c

Figure 1: T2W sagittal MRI image showing Multi-level disc degenerative changes; **Figure 2:** T2W sagittal MRI image showing Schmorl's node at L4-L5 level; **Figure 3a:** T2W Sagittal MRI image showing disc bulge at L4-L5 level; **Figure 3b:** T2W Axial MRI image showing disc bulge at L4-L5 level; **Figure 4a:** T2W Sagittal MRI image showing disc protrusion at L4-L5; L5-S1 levels; **Figure 4b:** T2W Axial MRI image showing disc protrusion at L4-L5 level; **Figure 5a:** T2W Sagittal MRI image showing disc extrusion at L5-S1 level; **Figure 5b:** T2W Axial MRI image showing disc extrusion at L5-S1 level; **Figure 6a:** T2W Sagittal MRI image showing disc sequestration at L5-S1 level; **Figure 6b:** T2W Axial MRI image showing disc sequestration at L5-S1 level; **Figure 7a:** T2W Sagittal MRI image showing annular fissure at L3-L4 level; **Figure 7b:** T2W Axial MRI image showing annular fissure at L3-L4 level; **Figure 8a:** T2W Axial MRI image showing Central Canal Stenosis at L4-L5 level; **Figure 8b:** T2W Axial MRI image showing Right Lateral Recess Stenosis at L4-L5 level; **Figure 8c:** T2W Sagittal MRI image showing Neural Foraminal Stenosis at L5-S1 level

Table 1: Age and sex-wise distribution

Age in years	Male	Female	Total	Percentage
1-10	0	0	0	0
11-20	0	0	0	0
21-30	2	1	3	3.00%
31-40	8	2	10	10.00%
41-50	22	17	39	39.00%
51-60	15	9	24	24.00%
61-70	9	5	14	14.00%
71-80	5	3	8	8.00%
81-90	1	1	2	2.00%
Total	**62 (62%)**	**38 (38%)**	**100**	

Table 2: Identification and characterization of lumbar disc degenerative changes

Inter-vertrbral disc level	Disc Involvement (n=143)	Disc bulge (n=62)	Annular tear (n=18)	Disc protruction (n=28)	Disc extrusion(n=19)	Disc sequestration (n=16)
D12-L1	5 (3.49%)	4 (6.45%)	0	1 (3.5%)	0	
L1-L2	9 (6.29%)	4 (6.45%)	1 (5.55%)	2 (7.14%)	1 (5%)	1 (6.25%)
L2-L3	19 (13.28%)	8 (12.9%)	2 (11.11%)	4 (14.28%)	3 (15.78%)	2 (12.5%)
L3-L4	26 (18.18%)	10(16.12%)	4 (22.22%)	5 (17.85%)	4 (21.05%)	3 (18.75%)
L4-L5	49 (34.26%)	22 (35.48)	6 (33.33%)	9 (32.14%)	6 (31.5%)	6 (37.5%)
L5-S1	35 (24.45%)	14 (22.58%)	5 (27.78%)	7 (25%)	5 (26.31%)	4 (25%)

Table 3: Sequelae of lumbar disc degeneration

Inter-vertrbral disc level	Cental canal stenosis (n=27)	Lateral recess stenosis (n=13)	Neural Foramen Stenosis (n=9)
D12-L1	0	0	0
L1-L2	2 (7.40%)	1 (7.69%)	1 (11.11%)
L2-L3	3 (11.11%)	1 (7.69%)	1 (11.11%)
L3-L4	5 (18.52%)	2 (15.38%)	4 (44.44%)
L4-L5	10 (37.04%)	6 (46.15%)	3 (33.33%)
L5-S1	7 (25.93%)	3 (23.08%)	5 (27.78%)
Total	**27(55.10%)**	**13 (26.13%)**	**9(18.37%)**

Out of a total of 100 patients studied, it is observed from Table 1 that males are more commonly affected than Females (i.e. 62% of total patients). The most common age group involved is between 41-50 years (i.e. 39% of all age groups involved). From Table 2 it is observed that, a total of 143 discs are involved. So an average of 1.43 discs is involved per patient. The most commonly affected lumbar disc is the L4-L5 disc (i.e. 34.26% of discs involved). Annular fissure was seen in 18 discs (i.e. 12.58% of disc involvement). L4-L5 was the most common intervertebral disc involved with annular fissure (i.e. 33.33% of annular fissures). Disc herniation was seen in 63 discs (i.e. 44.05% of disc involvement). Disc protrusion in 28 discs (i.e. 19.58% of disc involvement), disc extrusion in 19 discs (i.e. 13.28% of disc involvement) and disc sequestration in 16 discs (i.e. 11.18% of disc involvement) was noticed. A total of 62 disc bulges were seen (i.e. 43.35% of disc involvement) and disc bulge was common at L4-L5 level, (i.e. 35.48% of disc bulges). From Table 3 it is observed that, spinal canal stenosis was seen in 49 discs (i.e. 34.26% of disc involvement). Central canal stenosis was seen in 27 discs (i.e. 55.10% of discs involved with spinal stenosis). Lateral recess stenosis was seen in 13 discs (i.e. 26.53% of discs involved with spinal stenosis). Neural foramenal stenosis was seen in 9 discs (i.e 18.37% of discs involved with spinal stenosis).

DISCUSSION

Low back pain secondary to lumbar disc degeneration is the most common problem encountered by most people now a days. MRI is an excellent non-invasive imaging modality to assess the intervertebral disc pathology. Males are most commonly affected than females. It is probably because of increased mechanical stress and injury[4]. The findings of our study were consistent with other studies[5]. The most common age group involved is between 41-50 years which was comparable with other studies[5]. Loss of T2 hyper-intense signal on MRI is the most common MR imaging abnormality noted. The normal disc appears hyper-intense on T2W images because of high water content. Loss of water content in the disc results from replacement of glycosaminoglycans with-in the nucleus puposus with fibrocartilage which causes loss of signal intensity on T2W images of the degenerated disc[6]. Multiple discs are involved rather than single disc in most patients which is also in concordance with past studies[7]. Disc degeneration and diffuse disc changes are more common at L4-L5 and L5-S1 levels[5] and least common at L1-L2 level. Sequelae of lumbar disc degeneration like spinal canal stenosis was more common at L4-L5 level followed by L5-S1 level.

CONCLUSION

Lumbar disc degenerative changes are more common in males (62%) compared to females (38%). The most common age group involved is between 41-50 years (39%). Multiple levels of disc involvement is seen rather than single disc in most patients. The most commonly affected disc is the L4-L5 intervertebral disc (34.26%). Disc herniation i.e Disc protrusion, extrusion and sequestration; annular fissure and spinal canal stenosis is more common at L4-L5 level. The lumbar disc between L1-L2 is least commonly affected. Thus MRI is a very useful tool in detecting disc pathology. Because of its multi-planar image acquisition capability, excellent soft

tissue contrast and lack of radiation exposure, it proved to be a standard imaging modality in identifying and characterizing intervertebral disc changes.

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