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Magnetic Resonance Imaging of Degenerative Disease of theLumbar Spine

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Abstract
Introduction: *In Low backache patients of 35 to 50 yrs age group, degenerative disc disease was found to be the most common culprit. The superior soft-tissue contrast resolution of MRI has allowed for noninvasive detailed anatomic evaluation of the spine without radiation exposure and is considered the imaging modality of choice for detection of an actual cause of radicular symptoms versus regular age-related changes. The most commonly affected region is the lumbar spine in acquired degenerative disease.*
Purpose: *Role of MRI in the evaluation of the degenerative disc changes in the lumbosacral spine in patients with low backache.*
Materials and Methods: *An observational cross-sectional study of degenerative changes of the lumbosacral spine in patients with low backache referred to the department of Radio-diagnosis, KIMS, Amalapuram, A.P.*
Machine: PhilipsAchieva, 1.5 Tesla MRI machine.
Duration:- For period of two months (1st July2019- 31 August 2019).
Sample size- 186.
Results: *Out of a total of 186 patients, the incidence of degenerative disc changes is more in females (107) compared to males (79) with a ratio of 1.35:1. Most of the patients showed osteophytes, schmorl's nodes, loss of lumbar lordosis, ligamentum flavum hypertrophy, facet joint arthrosis, endplate (modic) changes. Disc bulges and herniations were the disc contour abnormalities found in patients with degenerative disc disease. The most common site for bulges and herniations was the L4-L5 intervertebral disc level.*
Conclusion: *MRI is the modality of choice for imaging of degenerative disease of the lumbar spine.*
Keywords: *MRI, lumbar spine, intervertebral disc,disc degenerative changes.*

Introduction

For imaging of the lumbar spine, the most common reason is low backache. In patients younger than age 45, low back pain is the leading cause of disability. The causes of the low backache are degenerative/acquired and congenital spinal stenosis, neoplasm, infection, trauma, inflammatory or arthritic processes. However, the most common culprit was acquired "degenerative" spondylotic changes as the cause of the central canal, subarticular recess, and neuroforaminal compromise[1]. A combination of the bone, ligament, joint, and disc disease, leads to acquired degenerative disease. The lumbar spine is the most commonly affected region, followed by the cervical spine[2].

Radiographs may provide an inexpensive screening tool of the spine, including osseous detail, alignment, stability, and postoperative evaluation of hardware and fusion. An appropriate initial imaging tool in patients with back pain is a lateral lumbar spine radiograph[3,4].

MDCT provides superior detail of cortical and trabecular bone, fracture, spondylosis, ligamentous ossification, spondylolysis, and facet joint arthropathy with encroaching osteophytes compared with MRI. MRI is more reliable than CT in detecting compressive nerve lesions, although CT can accurately distinguish disk herniations[5].

The superior soft-tissue contrast resolution of MRI has allowed for noninvasive detailed anatomic evaluation of the spine without radiation exposure and is considered the imaging modality of choice for detection of the cause of radicular symptoms versus normal age-related changes. Different pulse sequences applications allow for image acquisition to exploit tissue composition[6]. T1-weighted image provides optimal contrast between the internal components of the spinal canal and bright epidural fat.

In general, compared to T1-weighted images, T2-weighted images have higher contrast differentia-tion. Application of short tau inversion recovery (STIR) sequences or Fat-suppression techniques allow more conspicuous detection of marrow edema. Fluid-weighted sequences are useful for visualizing disk desiccation, high-intensity zones, and Modic end-plate changes. Gradient echo sequences allow for delineation of bone and disc margins, providing excellent contrast between the spinal cord and surrounding subarachnoid space and visualization of the exiting cervical nerve roots.

Aims and Objective

- For characterization of the disc degenerative changes of the lumbar spine using MRI.
- To evaluate the extent of involvement of the degenerative disc disease and its sequelae in the lumbar spine.

Materials and Methods

Study design: Hospital-based cross-sectional and observational study.

Source of data and Sample Size: 186 patients with low back pain referred from orthopedic and neurosurgery department.

Study Period: The duration of the study was two months from 1st July 2019- 31 August 2019

Study Area: Department of Radio-diagnosis, Konaseema institute of medical sciences and research foundations, Amalapuram, A.P.

Inclusion Criteria: Patients with low back pain referred to the department of Radio-diagnosis, KIMS, Amalapuram, A.P. after obtaining verbal consent.

Exclusion Criteria: We have excluded:

- Pregnant women.
- Patients who underwent recent interventional procedures.
- Post-operative cases.
- Patients with cardiac pacemakers /ferromagnetic aneurysmal clips / metallic orthopedic implants / cochlear implants /intraorbital metallic foreign bodies.
- Severe claustrophobia.
- Subjects unwilling to participate in the study.
- Patients with a history of trauma, prior surgery, spinal infections, active malignancy.

Equipment Used: PHILIPS Achieva 1.5 T MRI machine.

MRI Study Protocol: Sagittal TI-weighted, T2-weighted, and axial T2 - weighted, sagittal, and coronal STIR sequences were obtained usingthe standard technique in all the cases. The final report was subsequently compiled by interpretation of above all sequences.

Results: From total 186 patients, 79 patients (i.e.42% of total patients) were males and 107 patients (i.e.58% of total patients) were females(Table 1, Fig 1). The most common affected age group was 31 -50 years(Table 2, Fig 2).

Table 1

Sex distribution		
Sex	**No.of Patients**	**Percentage**
Males	79	42%
Females	107	58%

Figure 1

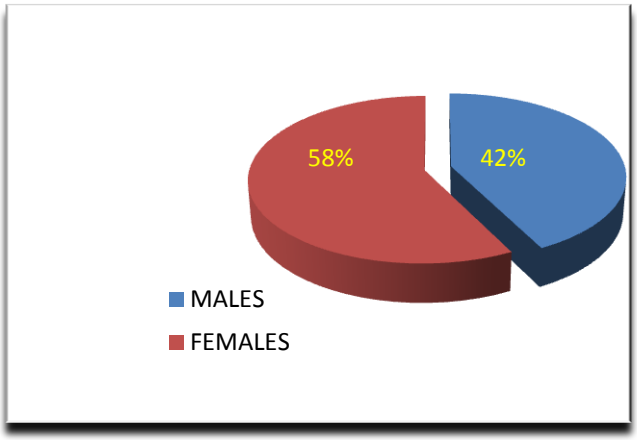
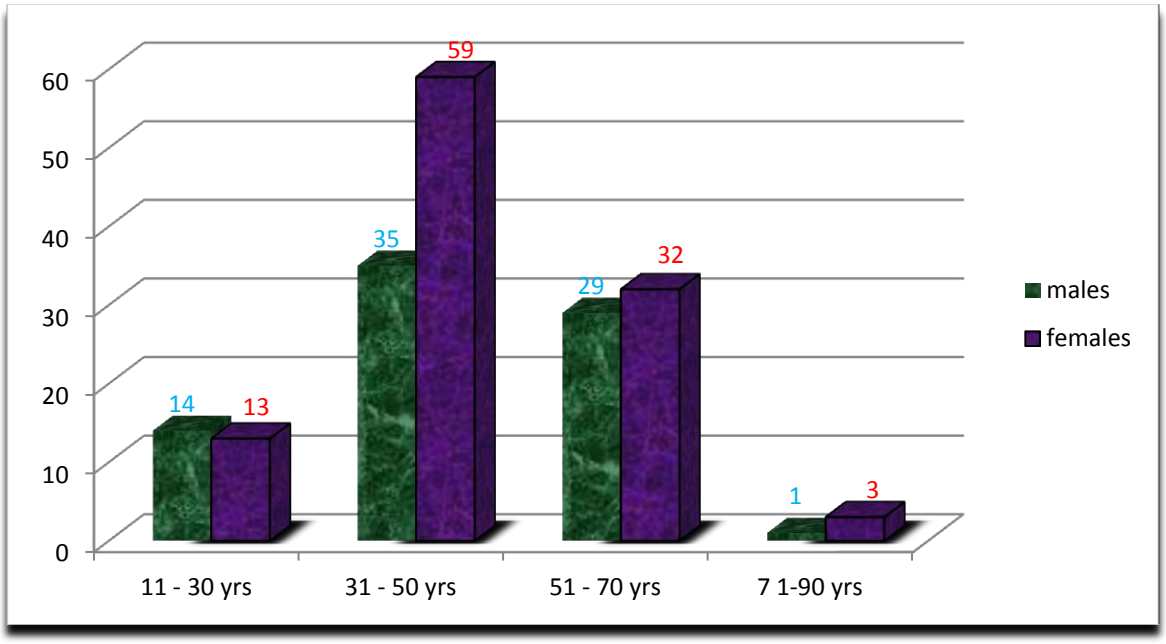


Table 2

Age and Sex Distribution			
Age (Yrs)	**Males**	**Females**	**Total**
11 - 30	14	13	27
31 – 50	35	59	94
51 – 70	29	32	61
71 – 90	01	03	04
TOTAL	79	107	186

Figure 2

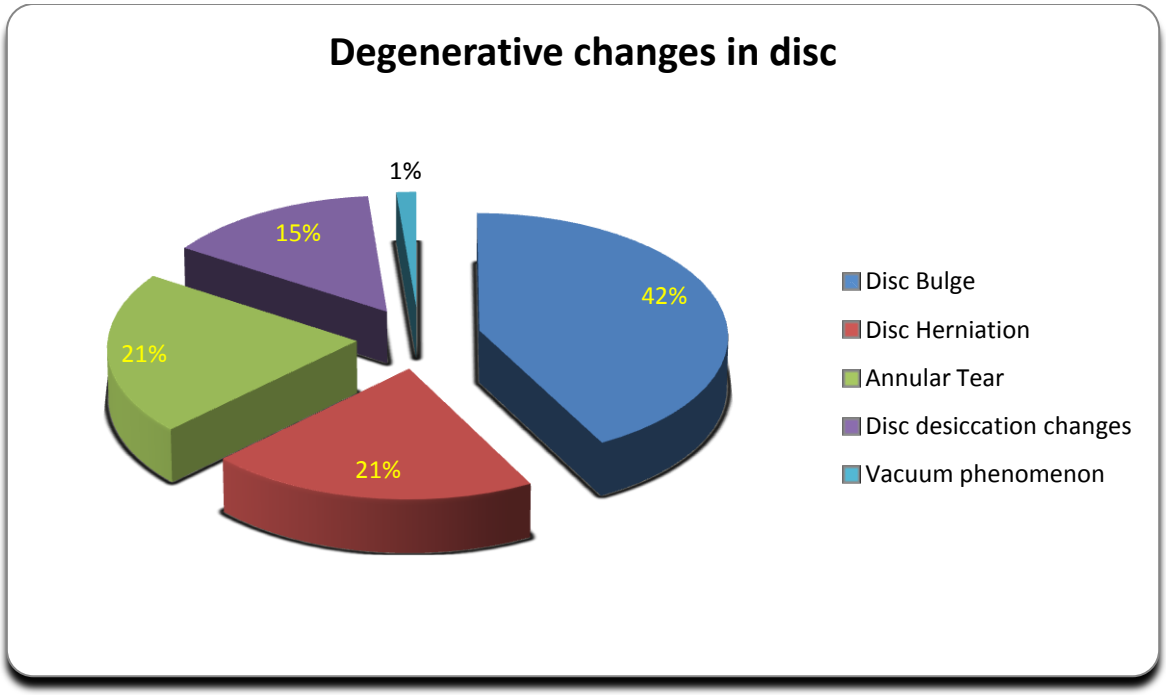


The degenerative changes found in the intervertebral disc levels include disc bulge, disc desiccation changes, annular tears, disc herniation, and vacuum phenomenon with a frequency, as shown in table 3, figure 3,Image1.

Table 3

Degenerative Changes In Disc	
Disc Changes	**No.of Patients**
Disc bulge	186
Annular tear	94
Disc herniation	90
Disc desiccation changes	64
Vacuum phenomenon	06

Figure 3

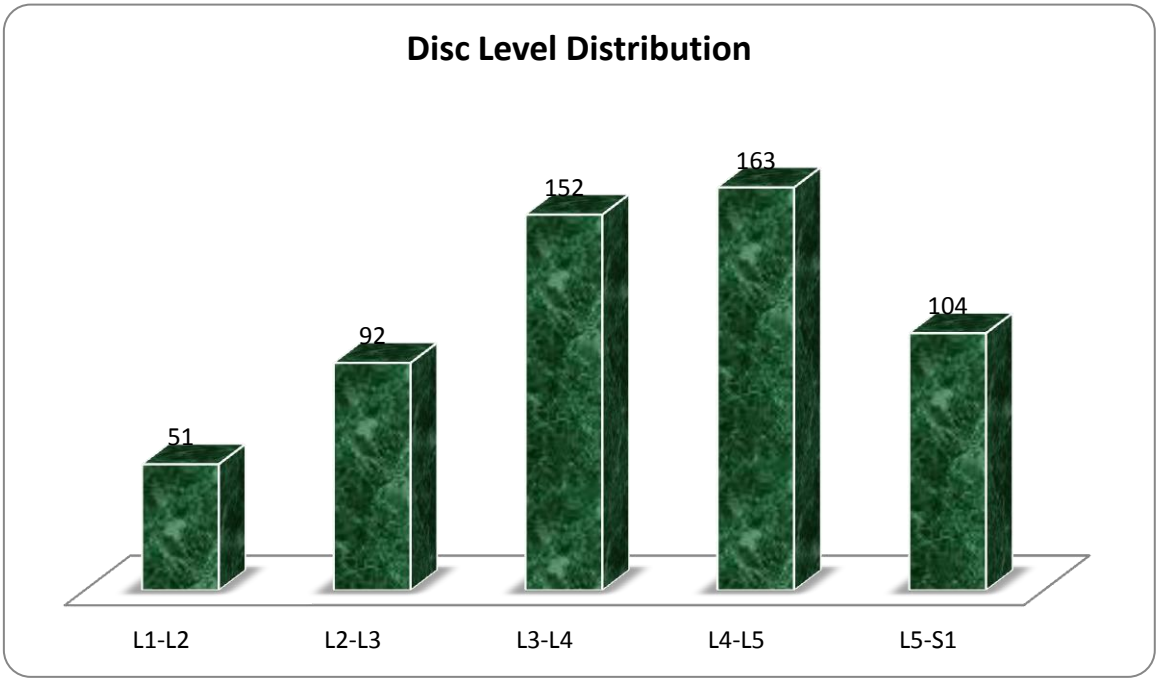


Disc bulge noted in 562 discs (i.e.60.4% of disc involvement) with an average of 3 discs involvement per patient. Disc bulge was common at L4 – L5 level (163 patients, i.e., 29% disc bulge) & L3 – L4 disc level(152 patients, i.e., 27.04% disc bulge) as shown in table 4, figure 4, Image 1.

Table 4

Disc Level Distribution	
Disc Levels	**No. of Patients**
L1 – L2	51
L2 – L3	92
L3 – L4	152
L4 – L5	163
L5 – S1	104

Figure 4



Disc Herniation noted in 134 discs amongst which Protrusion in 128 discs(95.5% of disc herniations)extrusion in 05 discs (i.e. 3.7% of disc herniations), and broad-based disc herniation in 01 disc(0.74%). Herniation was common at L4 –L5 disc level in 47 patients (i.e., 35.07% of herniation),Image 1&2.

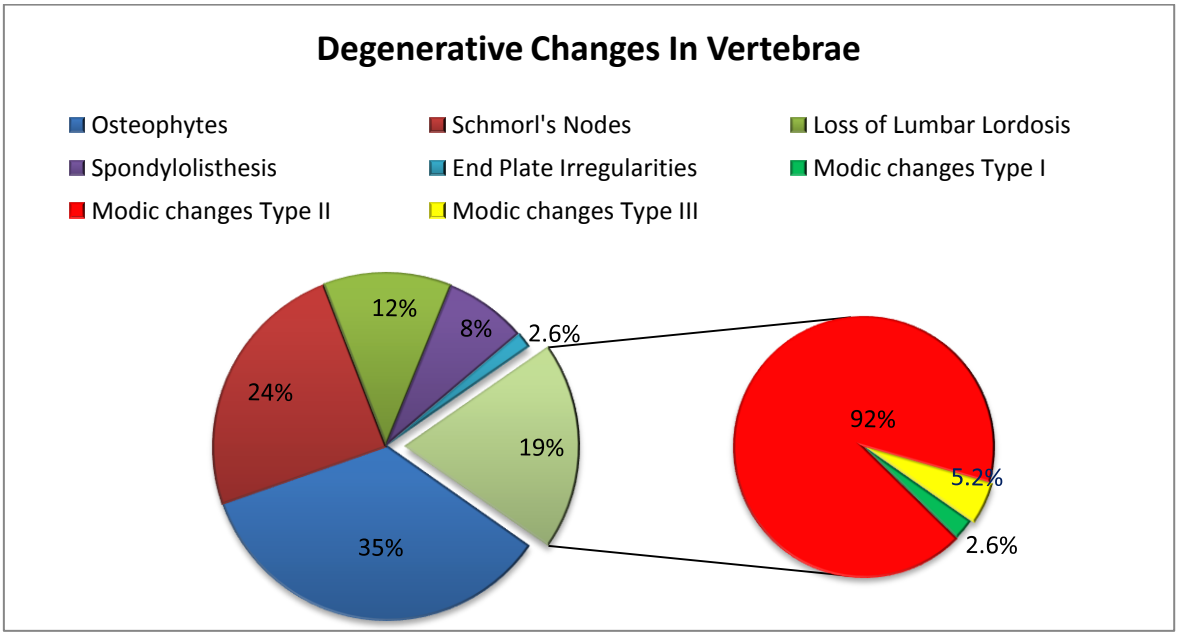
Annular tears were found to be in 94 patients (i.e., 50.53% of total patients) with a preponderance at L4 –L5 disc level(38.75% of the total, annular tears), Image 1.

Degenerative findings noted in vertebrae were osteophytes, schmorl'snodes(image 6), modic changes, loss of lumbar lordosis, endplate irregularities, and spondylolisthesis with frequencies as shown in table 5, figure 5. Amongst Modic changes, Type II was found to be the most common (92% of modic changes),Image 4.

Table 5

Degenerative Changes In Vertebrae	
Vertebral Changes	**No.of Patients**
Osteophytes	137
Schmorl's Nodes	96
Modic Changes	74
Loss of Lumbar Lordosis	47
Endplate Irregularities	06
Spondylolisthesis	30

Figure 5



Osteophytes were found to be in 137 patients (i.e., 73.6% of total patients)(Table 5, figure 5). **Facet joint arthropathy**and **ligamentum flavumthickening** were seen in 81 disc levels (i.e., 8.7% of the disc involvement) & both were common at the L4 – L5 disc level(Table 6),Image 2.

Lumbar lordosis was maintained in 139 patients (74.73%), and loss of the lumbar lordosis was noted in 47 patients (25.27%)(Table 5, figure 5),Image 5.

Spondylolisthesis is the form of anterolisthesis or retrolisthesis was found in 30 patients (i.e., 16.12% of total patients)(Table 6). Anterolisthesis (i.e. 14.5% of spondylolisthesis) is common as compared to retrolisthesis (i.e. 2.68% of spondylolisthesis). Listhesis of the L4 vertebral body over the L5 vertebral body was common in both anterolisthesis & retrolisthesis(Table 5&6, figure 5, Image 1).

Table 6

As **incidental findings** vertebral hemangioma in 67 patients (i.e.

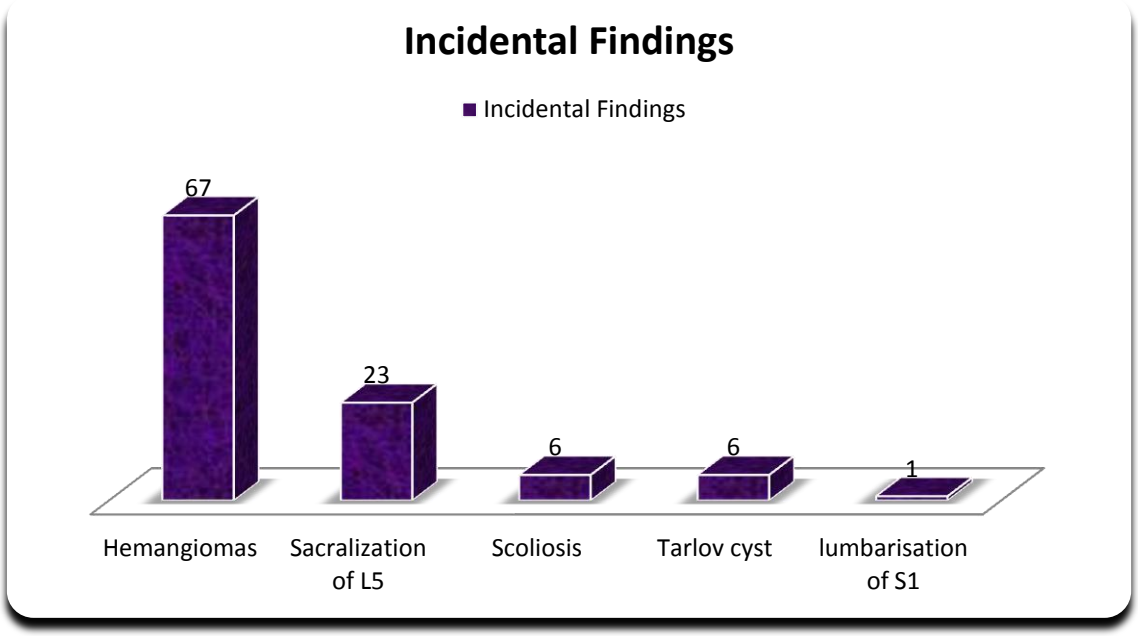
Inter-vertebral Disc Level	Disc Bulge	Annular Tear	Herniation			Disc desiccation changes	Ligamentum Flavum Hypertrophy	Facetal Arthropathy	spondylolisthesis	
			Protrusion	Extrusion	Broad-Based				Anteroli sthesis	Retrolis thesis
L1 – L2	51	06	06	00	00	09	00	02	00	00
L2 – L3	92	13	16	00	00	09	06	03	00	01
L3 – L4	152	42	25	00	00	20	13	07	01	00
L4 – L5	163	62	41	05	01	45	21	15	15	02
L5 – S1	104	37	40	00	00	37	10	04	10	01

36% of total patients),Image 7, sacralisation of L5 vertebra in 23 patients (i.e.,12.3% of total patients) scoliosis and tarlov Cyst in 06 patients (i.e.,3.2% of total patients), lumbarisation of S1 in one patient (i.e.0.53% of total patients) were found(Table 7,figure 6).

Table 7

Incidental Findings	
Findings	**No. of Patients**
Hemangiomas	67
Sacralisation of L5 vertebra	23
Scoliosis	06
Tarlov Cyst	06
Lumbarisation of S1	01

Figure 6



Discussion

In our study female preponderance of degenerative disease in intervertebral discs of the lumbar spine was seen, while male preponderance was found in the study done by **Suthar P**, et al. in 2015[7]

In a retrospective study by **Verma et al.** in 2011, the L4-L5 level, followed by the L5-S1 level, was found to be the most common levels showing degenerative changes while in our study L4-L5 followed by L3-L4 were found to be most common[8].

In a study by **Yong et al.** in 2003**,** in disc herniations, protrusions were found to be more common than extrusions, which is found similar to this study[9].

In a study by **Noha Osman *et al.*** in 2017, the L4-L5 intervertebral disc was most common with disc desiccation changes, which was similar to this study[10].

Spondylolisthesis was found to be more common in L4-L5 level similar to various studies[7]

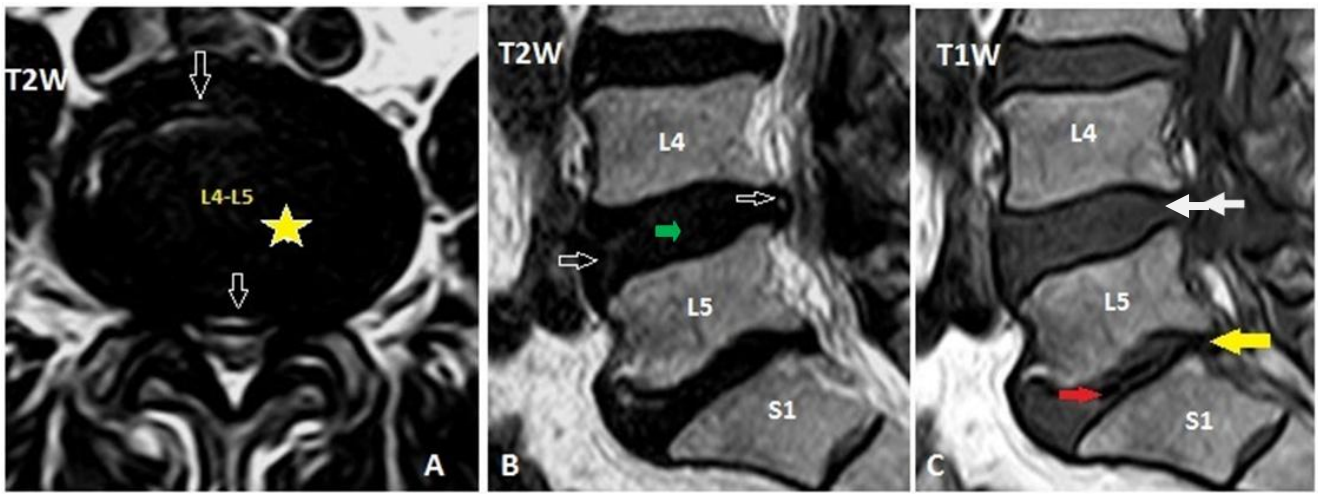


Image 1 showing generalized disc bulge(☆), Annular tear(⇨), Disc herniation(solid white arrow), Disc desiccation changes(➡), Vacuum phenomenon(red arrow),spondylolisthesis(yellow arrow) in axial T2W(A),sagittal T2W(B) and T1W(C) images.

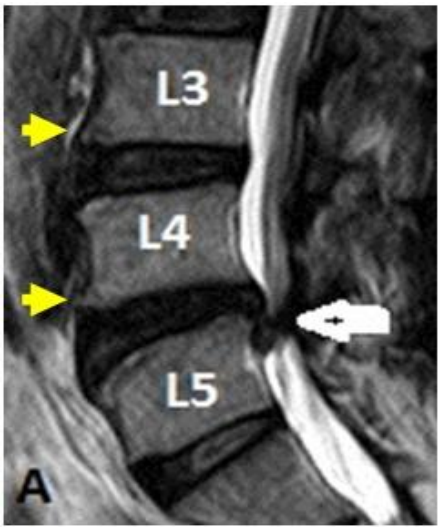


Image 2 depicts osteophytes(yellow arrow) and disc extrusion(white arrow) in sagittal T2W image

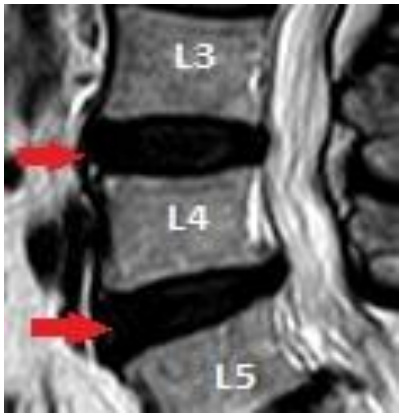


Image 3 showing disc desiccation changes in L3-L4 and L4-L5 intervertebral disc level in T2W sag image (red arrows)

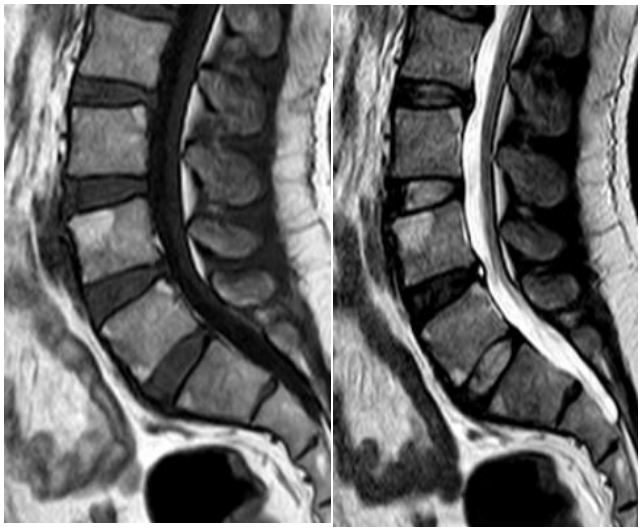


Image 4: Type II Modic endplate changes showing sagittal T1W(A) and T2W(B) hyperintensities along the subchondral endplates.

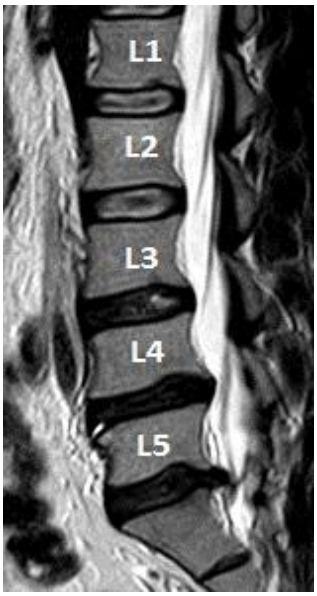


Image 5 depicting loss of normal lumbar lordosis in sagittal T2 weighted MRI sequence

Image 6 showing multilevel Schmorl's nodes (red arrows) in sagittal T2W images.

Image 7 depicting hemangioma in T2W sequences (red arrow).

Conclusion

Degenerative changes in the lumbar spine were found to be the most common culprit for low back pain, especially in the age group of 31 to 50 years with a female preponderance. The most common disc level involved in disc bulges, disc herniations, disc desiccation changes,ligamentum flavum hypertrophy, facet joint arthropathy, annular tears, and spondylolisthesis was found to be L4-L5. Endplate irregularities, vacuum phenomenon, and broad-based herniation were found less common. Amongst all the lumbar disc levels, degenerative changes, least commonly involved in the L1-L2 level. For characterization of degenerative changes in the lumbar spine leading to low back pain due to its superior delineation of soft tissue and radiation-free imaging, the MRI is the modality of choice.

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