Original Article

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Radiology Section

Evaluation of Degenerative Lumbosacral Diseases and Common Location of Disc Herniations causing Radiculopathy

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ABSTRACT

Introduction: Low back pain is a common cause of morbidity in all individuals. An accurate diagnosis regarding the type and extent of pathology is essential for operative as well as non operative treatment. The most widely used diagnostic modality to asses back pain are X-ray and MRI. X-ray though inaccurate, is cheap and readily available along with the drawback of ionizing radiation and less soft tissue detailing.

Aim: This study was under taken to study the various imaging findings in degenerative diseases of lumbosacral spine and common location of disc herniation causing radiculopathy.

Materials and Methods: The study was prospective study design. Symptomatic patient referred from various referral hospitals and units, with history of backpain were referred to the Department of Radiodiagnosis, Navodaya Medical College. Total 100 patients with backpain who underwent MRI were included in the study from October 2012 to March 2014. Investigation, clinical examination and X-ray were performed and findings were compared with MRI.

Results: Of the total 100 patients evaluated, most of the spine changes were of degenerative type, of which disc degeneration was the major cause of backpain. Lumbar spine was more significant in involvement than thoracic spine in the study group and also among both the genders, females had higher preponderance with correlation of findings, found a higher incidence in 4th decade of life.

Conclusion: Most common signs being of degenerative causes of back pain and the most common age group being in the fourth decade of life. The finding in this study was that degenerative discs of the lumbar spine occur most commonly at L4/5 and L5/S1. Diagnostic value of MRI in the study offers a reliable evaluation with high specificity and positive predictive value, in order to make appropriate therapeutic decisions.

Keywords: Anatomical diagnosis, Backache, Lumbar spine

INTRODUCTION

In various age groups, backache is the major cause of concern. As compared to traditional X-ray investigation, MRI has turned out to be the most important imaging technology in diagnosis of spine pathology to detect disease and its progress along with precise route to operative improvement in the condition of patient.

It was found, in a study that both physicians and patients preferred MRI to radiographic evaluations but evaluations at the primary care setting had very little additional benefits to the patients because of increasing cost of care and increasing number of patients kept getting operated for spine disease [1].

The discs receive nutrition by diffusion of fluid from the marrow of the vertebral bodies and via the annulus fibrosus from the blood vessels surrounding it. Ageing may interfere with disc nutrition and further increase the degenerative processes within the cartilaginous endplate and the vertebral body [2].

It is clear that MRI can detect a great amount of lumbosacral disease, but its significance of clinically remains unknown [3]. In the initial assessment of patients with acute on set low backpain, the plain film radiography is hardly ever useful. Two large retrospective studies have been demonstrated that, the low yield of lumbar spine radiographs [4,5].

In patients with worsening neurologic deficits or a suspected systemic cause of backpain such as infection or neoplasm, then MRI or CT studies should be considered. While referred for surgery, these imaging studies may also be suitable [6-8].

By MRI, the difference between the nucleus pulposus and the inner annulus fibrosus is not possible. Regular disks generally do not expand past the margins of the adjacent vertebral our bodies. However, diffuse extension beyond the margins by

way of 1 to 2 mm may additionally occur in a few histologically regular disks [9]. MR is very sensitive for detecting sequestered disc fragments [10].

Because of variety of environmental factors, life style, genetic and also of normal aging process, degeneration of inter vertebral disc may becomes complex and begins early in life. Mild degree of degenerative changes may consider as physiological and should be considered pathologic only if these abnormalities are causing clinical signs and symptoms. For LBP of degenerative cause including the vertebral periosteum, facet joints, ligaments and disc, different structures of the spine are accountable. The most common location of these changes is lumbar spine.

Osseous changes related to disc degeneration vertebral bodies [11]

1. Osteophytes
2. End plate and marrow changes (modic changes)-

   Type-1: Decreased signal on T1WI, increased signal on T2WI (inflammatory tissue).

   Type-2: Increased signal on T1WI, follows fat on T2WI(fatty marrow changes).

   Type-3: Decreased signal on T1 and T2 WI (osteosclerosis).

Facet joints

1. Subchondral sclerosis with cartilage loss and cyst formation
2. Osteophyte formation with hypertrophy of articular processes
3. Vacuum joint phenomenon and joint effusion
4. Hypertrophy and calcification of ligamentum flavum

Posterior spinous processes (Baastrup's Disease)

1. Breakdown of interspinous ligaments
2. Bursae form between spinous processes (high signal on T2WI)
3. Decreased space between spinous processes
4. Subcortical sclerosis and faceted appearance
5. Osteophytes and entesophytes

The degenerative complex in acquired spinal stenosis comprises diffuse disc bulging, facet hypertrophy and ligamentous thickening, and redundancy [12].

There is confusion in the literature between changes in the disc because of ageing and the pathological progression of degeneration and efforts have been made to clarify and also to standardize the descriptions used in degenerative disc disease [13].

Unlike the head, where a survey examination may be adequate to delineate many clinical disorders, a survey examination of the spine is apt to be less rewarding. To obtain adequate examinations, spinal imaging requires clinical expertise, special equipment, specific imaging sequences, and perhaps imager interaction. Translation of the clinical characterisation and localisation of neurologic disorders potentiates MR's effectiveness. The same thorough neurologic and neurosurgical evaluation that is the key to an accurate clinical diagnosis is equally crucial in optimising MR scanning sequences because confirmation of the diagnosis is often possible.

As plain radiography gives only limited information for diagnostic, it cannot show the structural morphology of the intervertebral disc. On plain X-rays, disc herniation cannot be observe, whereas other degenerative joint disease findings, for example, narrowing of disc space, spurring, eburnation and vacuum sign can be clearly observed. Fifth lumbar radiculopathy, which occurs most commonly, causes lateral and anterior thigh and leg pain. Sufferers with low lower back ache and sciatica will have radiculopathy because of lower lumbar disc herniation. A disc herniation can bring about mechanical aggravation of these structures which thusly can bring about agony. This is exhibited as low back agony with conceivable radiculopathy if a nerve is influenced.

There is shortage of literature which dealing with the pattern of the disease and the patient profile. Hence, the present study was undertaken to provide a descriptive analysis of the affected discs and patient profile in patients undergoing MRI. The objective of the study was to study the various disc and osseous changes in degenerative disc diseases in patients with low back pain using a large Field of View (FOV) in lumbar spine MR imaging and to study common locations of disc herniations causing radiculopathy.

MATERIALS AND METHODS

This prospective study was conducted in the Department of Radiology. Total 100 patients who have visited Navodaya Medical College & Research Centre, Karnataka, India, for MRI during the study period from October 2012 to March 2014 was considered for the study. Selection of patient is based on low backpain on clinical presentation and referrals for MRI to detect pathology were chosen for the study. Ethical committee clearance was obtained. A written informed consent was obtained from all the patients prior to imaging and a proforma was filled after discussion with patient which includes record of various disc changes and locations of disc herniations causing radiculopathy.

Inclusion Criteria: Known complaints of low back pain. Prospectus of surgery. +ve or –ve signs on X-ray.

Exclusion Criteria: Known history of trauma, prior surgery in past one year, recent spinal epidural anesthesia.

All cases with known history of backpain will be subjected to an MRI scan.

Imaging protocols: Patients will be subjected to an MRI scan and X-ray lumbo-sacral spine as and when directed by the physician and subject to availability of an appointment.

Equipment - Hitachi Elite 0.3 Tesla scanner protocol

i) T1 weighted images in axial and sagittal plane

ii) T2 weighted images in axial, coronal and sagittal plane

iii) STIR images wherever required X-Ray GE 500MA X-Ray and image intensifier

Interpretation of the data

Study will evaluate presence or absence of vertebral changes, disc changes, thecal sac involvement, spinal cord involvement, posterior elements and paravertebral involvement.

STATISTICAL ANALYSIS

Descriptive statistics was used such as mean, Standard Deviation (SD) and proportion. The Chi-square test procedure tabulates a variable into categories for comparison between two categorical variables. A p-value less than 0.05 considered as significant and 0.01 as highly significant. The other parameters employed during the statistical analysis such as, sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV). All the statistical operations were done using SPSS v16.0 software.

RESULTS

The present study group consisting of 100 patients with complaints of low back pain is undertaken to study the spectrum of MRI findings in cases of low back pain which are referred to Navodaya Medical College and Research Centre.

Majority of the study subjects were belongs to age group 40-49 (34%) followed by 50-59 (28%), 30-39 (25%) and 20-29 (13%).

Female study subjects (55%) were more than male subjects (45%) [Table/Fig-1].

In our study, veretebral changes were seen in 71 patients (71%) against normal vertebrae in 29 patients (29%). Disc changes were seen in 92 patients (92%). Thecal sac changes were seen in 75 patients (75%), posterior elements changes were seen in 28 patients (28%) and cord changes were seen in one patient (1%) [Table/Fig-2]. Disc herniation and nerve root compression were common in patients who presented with backpain.

Age (in years)	Male	Female	Total
20-29	9	4	13
30-39	11	14	25
40-49	14	20	34
50-59	11	17	28
Total	45	55	100

[Table/Fig-1]: Age and sex distribution of study subjects.

Variables	Frequency (n=100)	Percentage (%)
Vertebral changes	71	71.0
Disc changes	92	92.0
Thecal sac changes	75	75.0
Cord changes	1	1.0
Posterior elements changes	28	28.0

[Table/Fig-2]: Changes related to disc degeneration.

Sensitivity: If MRI shows truly positive result, then chance of getting positive result in X-ray is 20.8%. Though we obtained an estimate of sensitivity as 20.8%, it could vary between 14.7%-32.75% [Table/Fig-3,4].

X-ray changes	MRI findings		Total
	Yes (%)	No (%)	
Yes	21 (100)	0	21
No	71 (89.87)	8 (10.13)	79
Total	92 (92)	8 (8)	100

[Table/Fig-3]: Comparison of MRI findings with X-ray findings.

Variable	Value (%)	95% Confidence Interval
Sensitivity	20.8	14.72 - 32.75
Specificity	100	63.06 – 100
Positive Predictive Value	100	83.90 – 100
Negative Predictive Value	10.1	4.47 – 18.98

[Table/Fig-4]: Diagnostic accuracy of MRI findings with X-ray findings.

Specificity: If MRI shows truly negative result, then chance of getting negative result in X-ray is 100%.Though, we obtained an estimate of specificity as 100%, it could vary between 83.90%-100% [Table/Fig-3,4].

PPV- If X-ray has a positive result, the chance of having MRI positive is 100%.

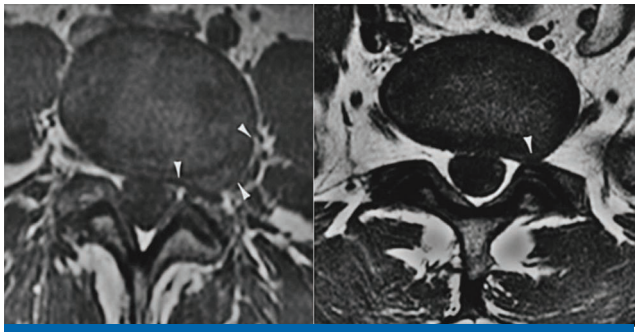
NPV- If X-ray has a negative result, the chance of having MRI negative is 10.1%.

The role of MRI has steadily increased and now it has the most preferred investigation of spine. It is also being used for pre and post operative evaluation. Complete evaluation of the spine was not possible with other modalities like conventional radiography and CT.

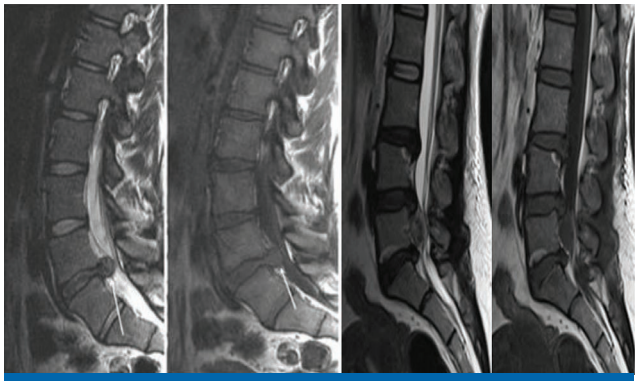
A major number of disease processes were diagnosed on MR often undetected on conventional radiography. Multiplanar MR provides remarkable diagnosis in the assessment of spinal and paraspinal structures [Table/Fig-5-8].

DISCUSSION

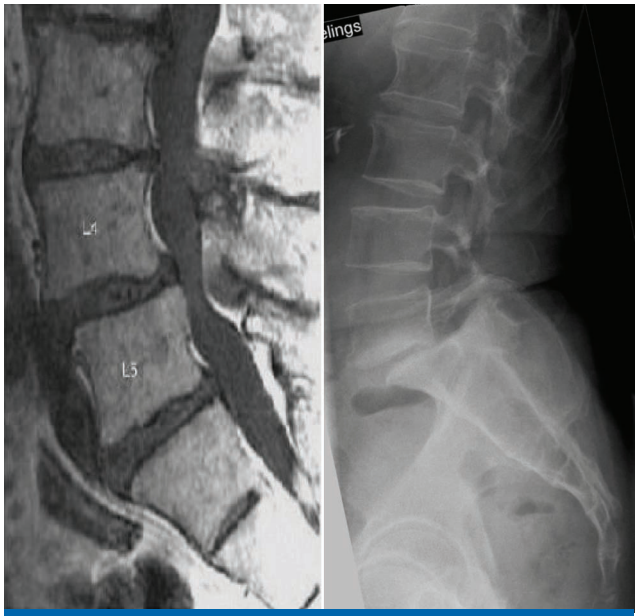
The present study attempts to study the various disc changes in degenerative disc diseases in patients with low back pain and common locations of disc herniations causing radiculopathy.



[Table/Fig-5a,b]: (a) Broad based protrusion (left); (b) Focal protrusion (right).

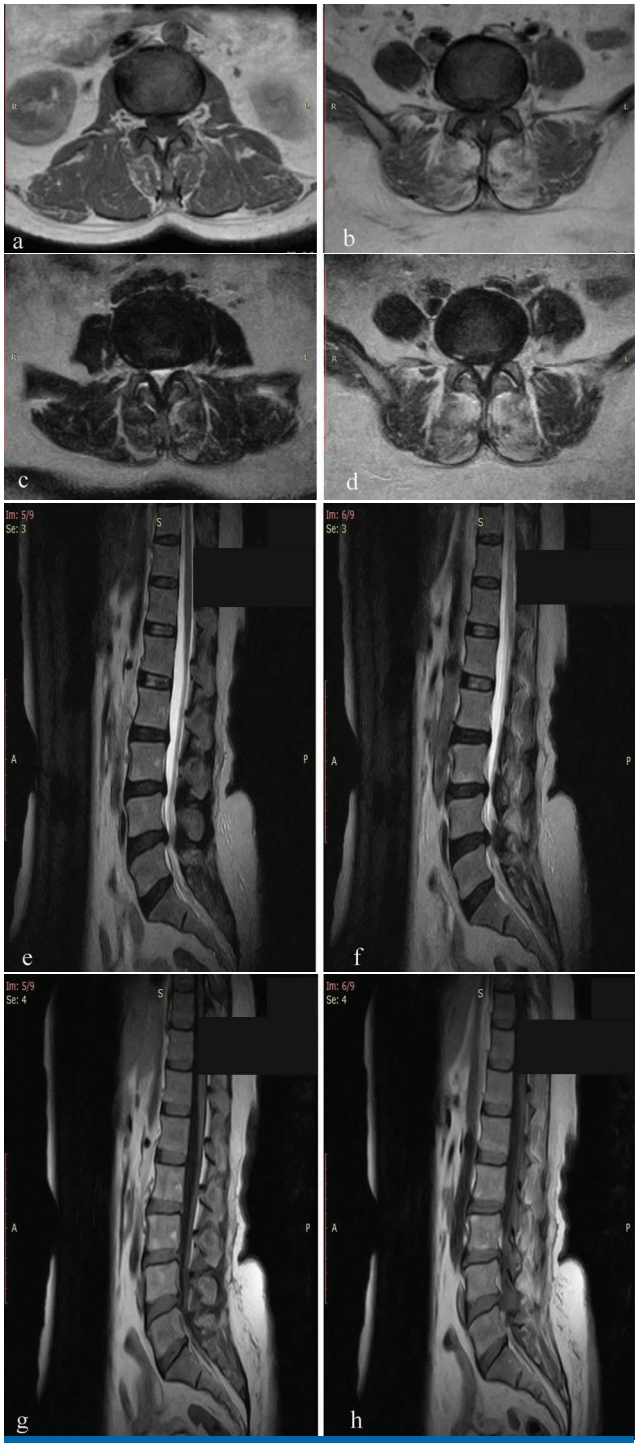


[Table/Fig-6a-b]: (a) Disc extrusion (left); (b) Disc sequestration (right).



[Table/Fig-7]: Sagittal MRI image showing listhesis of L4 over L5 and X-Ray image showing listhesis of L5 over S1.

Spine being the largest structure in the scaffolding of bones holding the body upright and subjected to changes because of its inherent structural complexity and multiple forces



[Table/Fig-8a-d]: MRI T2W SAG, T1W SAG, T2W Axial and T1W Axial shows, diffuse posterior protrusion at L4-5 level is compressing the thecal sac, indenting both L5 traversing nerve roots and causing mild secondary canal and foraminal stenosis. Diffuse posterior bulge at L3-4 level is indenting the thecal sac and mildly narrowing both neural foramina. Mild posterior bulges at L2-3 and L5-S1 levels.

experienced by the anatomical structures. In present study 100 patients with back pain who were referred for MRI were evaluated. Most common signs being of degenerative causes of back pain. The most common age group being in the fourth decade of life. LS spine protocol with T1,T2 and STIR images were the basis of all the findings.

The findings in this study are consistent with others that reported that degenerative disc of the lumbar spine occur most commonly at L4/5 and L5/S1. In a review of MRI scans of the lumbar spine in 100 consecutive patients who suffered from lowback pain, De Candido P et al., found that degenerative changes in the discs increased with age until the fifth decade of life. Sizeable dehydration and degeneration passed off in much less than 5% of the upper two disc spaces while L4/5 and L5/S1 had marked modifications in more than 20% [14].

In our study degenerative spine pathology was the most common finding affecting 92 patients (92.0%) with L5-S1 disc being most commonly affected followed by L4-L5 and L2-3disc, it may be happen due to highest mechanical stress at these levels [15-16] and with age predilection in the 40-49 years age group seen in 34 patients (34%) with mean age group of 43±10.76. The study also saw sex predilection of females 55 (55.0%) to males 45 (45.0%) seen as 1.2:1 ratio.

Due to heavy mechanical stress on lumbar section as compared to any other part of spine, it is more prone to be affected by degenerative changes. This is observed in our study.

Vertebral changes: In our study veretebral changes were seen in 71 patients (71%) against normal vertebrae in 29 patients (29%), whereas, intervertebral disk herniation was encountered in 41.7% [17].

Disc changes: In our study, disc changes were seen in 92 patients (92%) against normal discs in eight patients (8%), similar findings were found in the study conducted by Rai GS et al., found disc degeneration in 95% of their study group [18].

However, in an earlier study Lakadamyali H et al., found disc degeneration in 65.1% of their study group (190 subjects) [17].

Thecal sac: In our study, thecal sac changes were seen in 75 patients (75%) with predominance of thecal sac compression.

Spinal cord: In our study spinal cord involvement was seen in one patient (1%) against normal spinal cord in 99 patients (99%).

Posterior elements: In our study posterior element involvement was seen in 28 patients (28%) of the 100 cases against normal posterior elements in 72 patients (72%). In an earlier study Lakadamyali H et al., found posterior element changes in 76.3% of their study group (190 subjects) [17], which shows almost similar findings of our study.

Paravertebral structure: In our study, paravertebral structures were not seen to be involved.

Nerve root irritation may cause radiculopathy and can be associated with pain radiating to one or both lower extremities.

MRI is a vital modality for evaluating DDD and its sequelae because it presents extremely good multi-planar views of the spinal additives.

Despite the excellent detail in the images obtained, on the other hand, there is no connection between the imaging findings and pain symptoms [19,20]. In most studies which sought to correlate MRI findings. The disc changes and other associated pathology when correlated were seen to have variable severity, compared to available literature which can be attributed to varied geographic and environmental factors, daily activities of study subjects and large study group.

In MRI, patients of LBP diagnosed with herniated disc and have better short term outcomes treated by surgically as compared to conservative therapy [21], which in turn suggest that, prognosis would be better, if surgery was performed earlier, immediately after the diagnosis [22]. In instances of low backache with radiculopathy there has been robust chance of disc protrusion or extrusion causing nerve root compression, but there was no sizeable correlation between the severity of disease, affected person's feature, and severity of pain and MRI findings [23].

This study revealed the ability of MRI for superior evaluation of various degenerative spine changes including the detection, localisation, characterisation and assessment of the extent of disability and the strength of correlation between MRI and X-Ray findings confirms the value of MRI in assessment of back pain.

LIMITATION

A prospective study design was used with relatively smaller sample size. So we need to correlate MRI with X-ray in large population group to get more accurate detection.

CONCLUSION

Most common signs being of degenerative causes of back pain and the most common age group being in the fourth decade of life. The finding in this study was that degenerative discs of the lumbar spine occur most commonly at L4/5 and L5/S1. The small canal in patients with stenosis reasons thecal sac or nerve roots to impinge against the spine bone factors hence, inflicting radiculopathy and activity based pain. Further, MRI accurately detect, localise and characterise various pathology of spine causing back pain and helps in

arriving at a correct anatomical diagnosis there by guiding further management of the patient. In turn, it is an excellent, non-invasive radiation free imaging modality with multiplanar capabilities and excellent bone to soft tissue differentiation.

REFERENCES

[1] Jarvik JG, Hollingworth W, Martin B, Emerson SS, Gray DT, Overman S, et al. Rapid magnetic resonance imaging vs radiographs for patients with low back pain: a randomized controlled trial. JAMA. 2003;289(21):2810-18.
[2] Hurri H, Karppinen J. Discogenic pain. Pain. 2004;112:225-28.
[3] Baras JD, Baker LC. Magnetic resonance imaging and low back pain care for medicare patients. Health Aff (Millwood). 2009;28(6):w1133-40.
[4] Scavone JG, Latshaw RF, Rohrer GV. Use of lumbar spine films. Statistical evaluation at a university teaching hospital. JAMA. 1981;246:1105-08.
[5] Scavone JG, Latshaw RF, Weidner WA. Anteroposterior and lateral radiographs: an adequate lumbar spine examination. AJR Am J Roentgenol. 1981;136:715-17.
[6] Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg .1990; 72:403-08.
[7] 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;331:69-73.
[8] Wiesel SW, Tsourmas N, Feffer HL, Citrin CM, Patronas N. A study of computer-assisted tomography. The incidence of positive CAT scans in an asymptomatic group of patients. Spine. 1994;9:549-51.
[9] Rubin JB, Enzmann DR. Optimizing conventional MR imaging of the spine. Radiology. 1987;163:777-83.
[10] Sylven B. On the biology of the nucleus pulposus. Acta Orthop. 1951;20:275-79.
[11] Modic MT, Ross JS. Lumbar degenerative disk disease. Radiology. 2007;245(1):43-61.
[12] Major NM, Helms CA. Central and for aminal stenosis of the lumbar spine. Neuroimag Clin North Am. 1993;3:557-66.
[13] Recommendations of the Combined Task Forces of the North American Spine Society, American Society of Spine Radiology, and American Society of Neuroradiology Nomenclature and Classification of Lumbar Disc Pathology. Lippincott, Williams & Wilkins. 2001.
[14] De Candido P, Reinig JW, Dwyer AJ, Thompson KJ, Ducker TB. Magnetic resonance assessment of the distribution of lumbar spine disc degenerative changes. J Spinal Disorder. 1988;1:09-15.
[15] Bakhsh A. Long-term outcome of lumbar disc surgery: an experience from Pakistan: Clinical article. Journal of Neurosurgery: Spine. 2010;12(6):666-70.
[16] David G, Ciurea AV, Iencean SM, Mohan A. Angiogenesis in the degeneration of the lumbar intervertebral disc. Journal of medicine and life. 2010;03(2):154.
[17] Lakadamyali H, Tarhan NC, Ergun T, Cakir B, Agildere AM. STIR sequence for depiction of degenerative changes in posterior stabilizing elements in patients with lower back pain. AJR Am J Roentgenol. 2008;191(4):973-79.
[18] Rai GS, Gaur TNS, Mehra A. Senile degenerative changes in adult lumbar spine! - a prospective study. Journal of Evidence based Medicine and Healthcare. 2015;49(2):8491-99.
[19] Hangai M, Kaneoka K, Kuno S, Hinotsu S, Sakane M, Mamizuka N, et al. Factors associated with lumbar intervertebral disc degeneration in the elderly. Spine J. 2008; 8:732-40.
[20] Liuke M, Solovieva S, Lamminen A, Luoma K, Leino-Arjas P, Luukkonen R, et al. Disc degeneration of the lumbar spine in relation to overweight. Int J Obes (Lond). 2005;29:903-08.
[21] Saal JA, Saal JS. Non operative treatment of herniated lumbar intervertebral disc with radiculopathy: an outcome study. Spine.1989;14(4):431-37.
[22] Cowan NC, Bush K, Katz DE, Gishen P. The natural history of sciatica: a prospective radiological study. Clinical radiology. 1992;46(1):07-12.
[23] Modic MT, Ross JS, Obuchowski NA, Browning KH, Cianflocco AJ, Mazanec DJ. Contrast enhanced. MR imaging in acute

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