Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 1008 - 1016
Received 20 January 2021; Accepted 08 February 2021.

Role of MRI Lumbosacral Spine in Non-Traumatic Conditions Causing Low Back Ache

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ABSTRACT

To describe the MRI findings in patients with non traumatic causes of lowback ache, To analyze the various marrow signal intensity changes in lumbosacralregion.Describe the changes and to assess the usefulness of MRI as an imagingmodality in the diagnosis of non traumatic pathologies causing low backache.Low back ache is a debilitating condition affecting young and old adults alike. As one of the commonest complaints in orthopedic OPDs, the etiology and pathogenesis of non- traumatic LBA is varied and requires careful evaluation.

Keywords:

1. Introduction

The incidence of LBA has increased with mean age of patients decreasing over the years. This can be attributed to sedentary lifestyle and occupational hazards which include sitting for prolonged time leading to weakening of paraspinal muscles and abnormal posture.Non traumatic LBA can have varied causes ranging from herniated disc to neoplasms. [1-3] Thus, relatively safe and high diagnostically accurate modality is needed to determine the etiopathogenesis so that an appropriate treatment can be initiated benefitting the patient.Imaging of lumbar spine is considered appropriate in patients with six weeks of physical and medical therapy but still showing little improvement of symptoms. [4] Apart from this, patient presenting with red flags(History of cancer, Unexplained weight loss, immunosuppression, urinary infections etc) should raise serious concerns of underlying condition and should be advised imaging. [5] It is very important to correlate symptoms of patient with MRI findings especially since many nonspecific and incidental findings may be observed. Hence clinical features and patient history including age, occupation, location of symptom, duration of LBA, associated co morbidities and other risk factors must be taken into account while reading the MRI. [6,7] Lower back can be defined as area of the back corresponding to lumbar vertebrae. As the conus medullaris ends at L1/L2 levels in adults, myelopathy is generally not associated with LBA. Radiculopathy may or may not be associated with LBA and depends upon the underlying pathology. Myelopathy occurs due to compression of spinal cord and presents as paraparesis and may be associated with generalized non-specific LBA.[8]

According to ACR appropriateness criteria, acute or chronic, non-complicated LBA or radiculopathy with no red flags has a rating of 2 of performing MRI with no IV contrast which is at par with X-ray myelography and Tc99m bone scan SPECT. Acute or chronic non-complicated LBA including low-velocity trauma, elderly age group, osteoporosis, or chronic use of steroids has a rating of 7 while associated with suspicion of cancer, infection or immunosuppression in a patient with backache has rating of 8. [9,10] In addition to evaluating the primary cause of non-traumatic LBA, Lower back can be defined as area of the back corresponding to lumbar vertebrae. As the conus medullaris ends at L1/L2 levels in adults, myelopathy is generally not associated with LBA. Radiculopathy may or may not be associated with LBA and depends upon the underlying pathology. Myelopathy occurs due to compression of spinal cord and presents as paraparesis and may be associated with generalized non-specific LBA. [11-14] Inter-vertebral

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disc herniation can be evaluated using MRI sequences and sections through various planes and conditions such as bulge, protrusion, extrusion and sequestration can be identified. Sometimes a sequestered disc may resemble an extradural mass which can be distinguished using contrast studies.Other than degenerative conditions, congenital conditions such as scoliosis, sacralization/lumbarization, perineural cysts etc can also be well visualized and evaluated. Evaluation using Cobb's angle can detect degree of deformity and aid in correction of scoliosis. The nature of congenital cyst and associated pathologies such as hemorrhage and infection of the cyst can be evaluated using MRI. A gold standard modality for assessing spinal tumors. MRI of low Tesla strength has been successful in determining and recognizing tumors as cause of backache. [15] Now with advances in fields strength and better acquisition, spinal tumors can be evaluated based on their location, contrast uptake, and presence or absence of diffusion of the lesion.

2. Materials and Methods

The study will be carried out at the department of radio-diagnosis, Sri Lakshmi Narayana Institute of Medical Sciences from December 2018 to June 2020 with aim to diagnose and evaluate non traumatic low backache.Source of data -Patients with non-traumatic backache referred for MRI study to Department of Radio-diagnosis. Complete clinical history will be taken from the patient.Presence or absence of Radiculopathy will beevaluated.Sample size will consist of 100 patients fulfilling our inclusion/exclusioncriteria.
The MRI will be done on the advice of the referring doctor and no patient willbe made to undergo MRI for the sole purpose of thisstudy.

- Study period: 18months

Inclusion criteria :
Patients aged more than 18 years clinically referred for Lumbar spineMRI.Non traumatic lower backache and Bothsexes
Exclusion criteria:
Patients who are suspected or detected to have traumatic spine injuriesare excluded from thestudy.Postsurgical LS spinecases and Pregnantwomen.
Patient preparation:
Patients referred for MRI of the spine, will undergo examinationafter contraindications for MRI excluded and consent istaken.
Equipment:
Siemens 1.5 T MAGNETOM ESSENZA MRI scanner, standard surface and body coils were used for lumbosacral spine for acquisition ofimages

Sequences:

Conventional spin echo sequences Sagittal T2 weighted TSE (Turbo spin echo) of the lumbosacral spine, Sagittal T1 weighted TSE of the lumbosacral spine, Angled T2 weighted stacked axials L1 to S1, STIR (Short T1 inversion recovery) coronal. No Intravenous contrast will be required in thisstudy.
MRI PARAMETERS

	T1	T2	STIR

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TR	560ms	3360ms	4300ms
TE	12ms	95ms	53ms
FOV PHASE	100%	100%	100%
FOV READ	300mm	280mm	300mm
VOXEL SIZE	0.7x0.7x4.0mm	0.7x0.7x3.5mm	0.9x0.9x5.0mm
SLICE THICKNESS	4.0mm	3.5mm	5mm
FLIP ANGLE	150	150	150

Statistical analysis:
In Microsoft excel, data was entered and data sheet and analysis wereperformed.
Various descriptive statistics, proportions and frequencies were tabulated and calculated. Incidence and prevalence were calculated to find burden of disease and various causative factors and associated findings and evaluate them as a cause of non traumatic backache. Fisher exact test was the test of significance for categorical data. $p < 0.05$ was considered as statisticallysignificant.

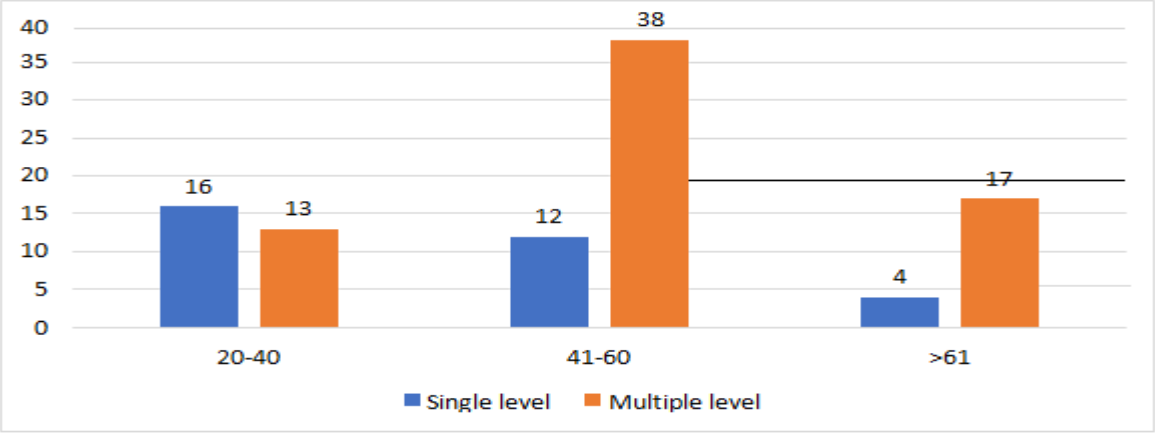
3. Results

Majority of the patients with backache had multi-level disc dehydration making them more susceptible to disc related problems.Most severely affected age group was 41-60 years comprising of 50% of the total population with 38% of them having multi-level involvement. In my study the age group of >61 years had least prevalence of backache reflecting the burden of disease on the middle aged population of this area.

TABLE 1: Single & Multiple Disc Level Involvement With Age

Age	Single level	Multiple level
20-40	**16**	**13**
41-60	**12**	**38**
>61	**4**	**17**
Total single /multi levels	**32**	**68**

FIGURE 1: Frequency Of Age Distribution With Disc Dehydration



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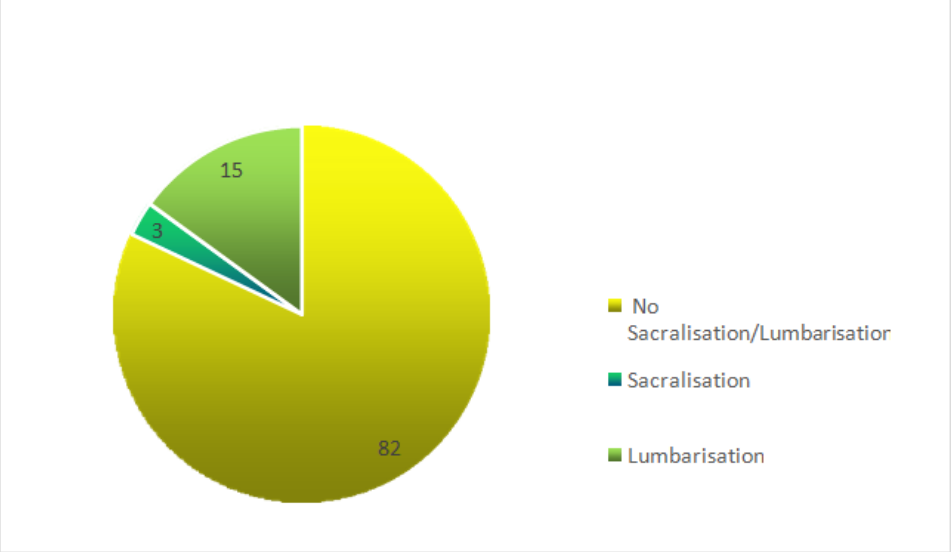
LSTV (Lumbo-sacral transitional vertebra) has generally been associated with backache and increased incidence of disc prolapse. In my study, 15% of population had sacralization of L5 making it more common than lumbarization (3%).

TABLE 2: Distribution Of Sacralisation & Lumbarisation

SACRALISATION/LUMBARISATION	FREQUENCY	PERCENTAGE
No sacralisation/Lumbarisation	82	82%
Lumbarisation	3	3%
Sacralisation	15	15%

FIGURE 2: Frequency Of Sacralisation & Lumbarisation



In my study L4/L5 IVD was the most common disc associated with non-traumatic LBA, followed by L5/S1 IVD with L1/L2 being involved least commonly.

TABLE 3: Distribution Of Disc Levels

DISC LEVELS	FREQUENCY	PERCENTAGE
L1/2	6	3.3%
L2/3	11	6.1%
L3/4	30	16.7%
L4/5	86	48%
L5/S1	46	25.6%

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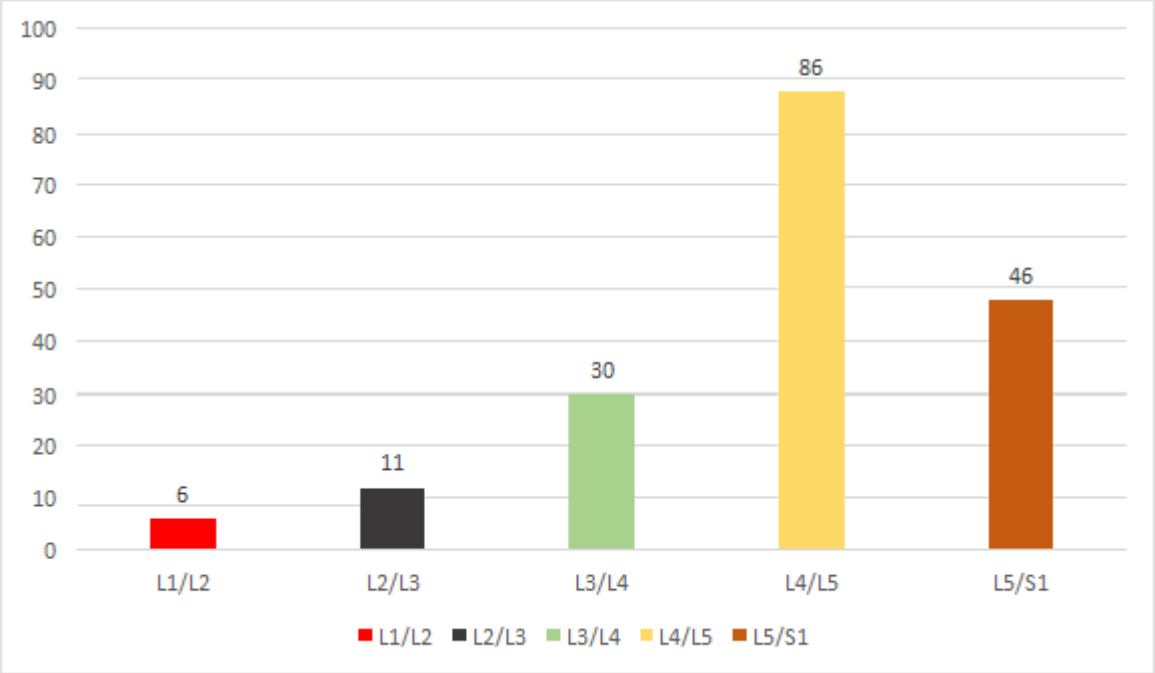
FIGURE 3: Distribution Of Disc Levels



16 % of the population (out of 100) were found to have spondylolisthesis. 8.93% ofthe discs (out of 179) surveyed had spondylolisthesis.
There is a positive correlation of spondylolisthesis with canal stenosis with a p value<0.05. 12 (out of 16) patients who had listhesis were found to have canal stenosis as well, thus leading to a total of 75% of patients with listhesis having canal stenosis.

TABLE 4: Incidence Of Listhesis With Canal Stenosis

LISTHESIS (16)	**CANAL STENOSIS**	
	YES	**NO**
ANTEROLISTHESIS	11	4
POSTEROLISTHESIS	1	0

Total listhesis patients =16. Total listhesis patients with no canal stenosis = 4

FIGURE 4: Percentage Incidence Of Listhesis With Canal Stenosis

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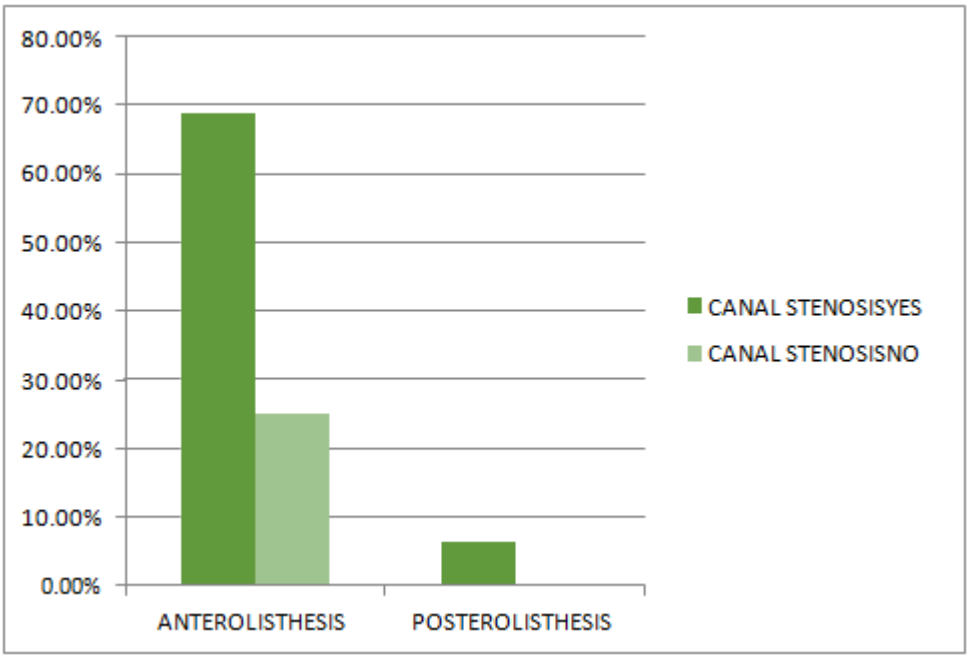
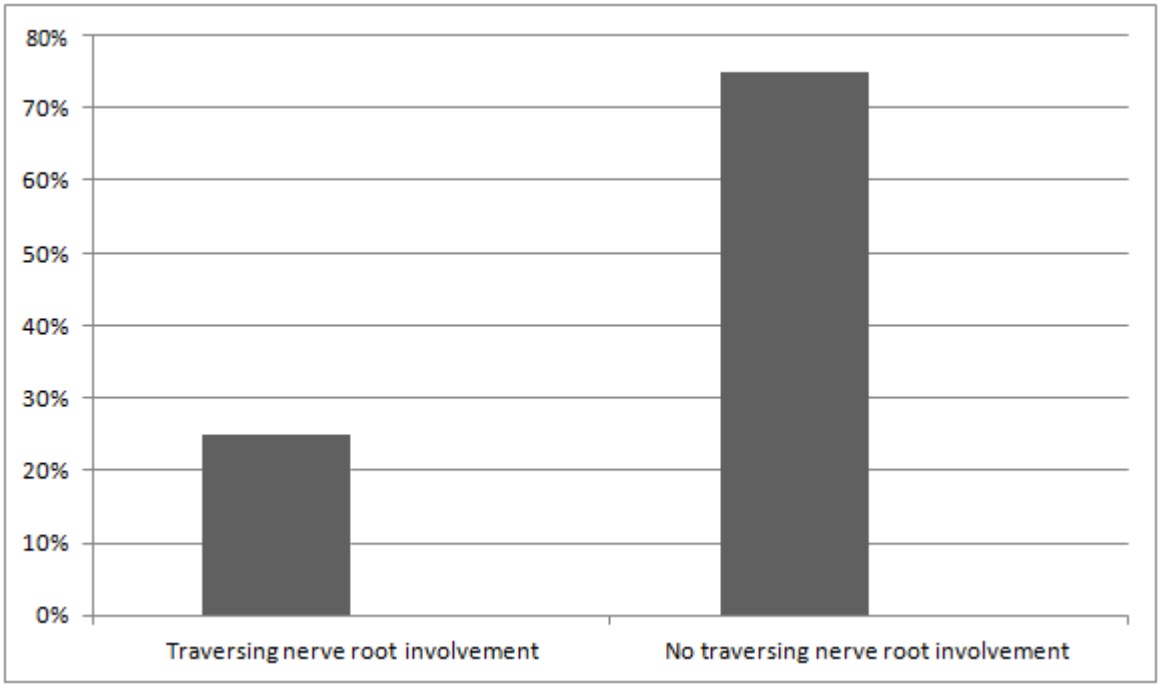


TABLE 5: Incidence Of Listhesis With Traversing Nerve Root Involvement.

LISTHESIS (n=16)	Traversing nerve root involvement	No traversing nerve root involvement
Anterolisthesis	4	12

FIGURE 5: Percentage Of Listhesis With Traversing Nerve Root Involvement.



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4. Discussion

Majority of the patients had multi-level disc dehydration. Most severely affected age group was 41-60 years comprising of half of the total population with 38% of them having multi-level involvement. Half of the surveyed population also had associated radiculopathy.15% of the surveyed population had sacralization of L5 vertebra while lumbarization was noted in 3% of the population. [16] L4/L5 IVD was the most common disc associated with non-traumatic LBA, while L1/L2 level IVD was least commonly involved. 16 % of the population surveyed were found to have spondylolisthesis with grade 1 anterolisthesis much more common. 15% of the population were found to have annular fissures of which the most common was a centralposterior annularfissure.97% of population surveyed had some form of disc herniation with disc bulge in 68% and disc protrusion in 20.1% population. Extrusion was frequently found to coexist with disc bugle and comprised 7.4% collectively. [17,18]

Lumbar canal stenosis was noted to be present in 55.8% of thepopulation. A positive correlation was found of spondylolisthesis with canal stenosis with a p value<0.05.15 patients had sacralization of L5 Vertebra out of which 10 had multi disc level involvement leading to a positive correlation between the two. 75% of patients with listhesis were also found to have neural foramina narrowing.VDs were found to have thickening of the ligamentum flavum out of which 69.5% had associated lateral recess narrowing and 48.4% were found to also have traversing nerve involvement in the form of compression and abutment. In 78.26% of the cases, ligamentum flavum was found to be hypertrophied and coexisting with facet joint arthropathy.16 % of the total observed IVDs were found to have Modic changeswith type 2 being the most common(11.7%). [18] 100 patients evaluated, 51% were clinically found to have radiculopathy defined as radiating pain either to back or to lower limbs, according to a study by Baron et al(2016)[65] 16-55% of patients suffering from LBA were found to have neuropathic component. The wide variation of range was attributed to differences in data collection and methodology as radiculopathy is a subjective finding and patients often report back pain radiating to ankle or knee (lower limbs) more frequently and may not be able to distinguish back pain (of annular fissure for example), from radiation pain to the back.[19]

Spondylolisthesis is another important cause of LBA and was evaluated in our study. It can be defined as slippage of one vertebra over another and nomenclature is based relative to the vertebra below. Causes of spondylolisthesis can be divided into 6 parts. According to Wiltse classification, the common causes of a non-traumatic spondylolisthesis includes congenital defects (pars interarticularis defect) this is referred to as Type 1 spondylolisthesis. Type 2 spondylolisthesis can be further divided into 3 parts. Type 2a is due to micro fractures in pars interarticularis due to hyperextension and overuse and is commonly seen in gymnasts and weight lifters. Type 2b is also caused by micro-fractures however the fracture in itself doesn't cause the defect but due to new bone growth over these micro-fractures, the pars interarticularis becomes longer, a longer par is more prone to slippage. Type 2c is purely traumatic listhesis (trauma to pars interarticularis).[20,21]

Modic type changes are defined as vertebral end plate signal abnormalities as noted on MRIs. They are classified into 3 types. Modic 1 refers to low signal (hypointensity) of vertebral end plate on T1W and high signal (hyperintensity) on T2W sequences, this represents inflammation and edema of the marrow. Modic 2 refers to high signal on T1W and T2W sequences, this represents marrow ischemia which has caused a conversion of normal red marrow into fatty yellow marrow. Modic 3 refers to low signal on both T1W and T2W sequences which is a result of bony sclerosis of end plates. [23] In our study of LBA we aimed to find out prevalence of

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Modic changes in the given population and observed out of the 179 discs evaluated, 16% (29) of the discs had Modic changes. The most common been Modic type 2 change was found to be in 21 discs while type 1 and type 2 changes were in 4 discs each.

5. Conclusions

Rapidly evolving society and multiple aids of assistance, the lifestyle trend of population in modern times has become more sedentary. This has led to various biomechanical problems due to lack of exercise and increased incidence of sitting occupation. MRI is an excellent modality with sensitivity and specificity equivalent to CT and contrast myelography and is helpful in detecting changes in spine especially in patients with red flag symptoms. Especially useful tool, MRI can direct treatment by ruling out other causes of non traumatic backache such as tumours and infections. Also as the modality is radiation free, and no contrast is needed in degenerative findings, MRI has been a useful tool in evaluation of non traumatic lower back ache.Although CT is a better imaging modality for detecting traumatic conditions such as fractures, non traumatic conditions especially related to disc herniation syndromes are better visualised on MRI making it a superior modality for detection and diagnoses of non traumatic conditions causing low back ache.

Funding: No funding sources
Ethical approval: The study was approved by the Institutional Ethics Committee

Conflict of interest
The authors declare no conflict of interest.

Acknowledgments
The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

References

[1] Berven S, Wadhwa R. Sagittal Alignment of the Lumbar Spine. Neurosurg Clin N Am. 2018Jul;29(3):331-339.

[2] Shiboi R, Hayashi S, Kawata S, Li ZL, Pieroh P, Koga H et al. Anatomical relation between the accessory process and pedicle in the lumbar vertebrae. Anat Sci Int 2018;93(4):430-6.

[3] Gardner-Morse M, Stokes IA, Laible JP. Role of muscles in lumbar spine stabilityin maximum extension efforts. J Orthop Res1995;13(5):802-8.

[4] Dowdell J, Erwin M, Choma T, Vaccaro A, Iatridis J, Cho SK. IntervertebralDisk Degeneration and Repair. Neurosurgery2017;80(3S):S46-54.

[5] Benneker LM, Heini PF, Alini M, Anderson SE, Ito K. Vertebral endplate marrow contact channel occlusions and intervertebral disc degeneration. Spine (Phila Pa 1976) 2005;30(2):167-73.

[6] Nachemson A, Lewin T, Maroudas A, Freeman MAF. In vitro diffusion of dye through the end plates and annulus fibrosus of human lumbar intervertebral discs. Acta Orthop Scand1970;41:589–607.

[7] Roughley PJ. Biology of intervertebral disc aging and degeneration: involvement ofthe extracellular matrix. Spine (Phila Pa 1976)2004;29(23):2691-9.

[8] Roudsari B, Jarvik JG. Lumbar spine MRI for low back pain: indications and yield. AJR Am J Roentgenol2010;195(3):550-9.

[9] Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Frequency, clinical evaluation, and treatment patterns from a U.S. national survey. Spine(Phila Pa 1976)1995;20(1):11-9.

[10] Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: a guidefor diagnosis and therapy. F1000Res. 2016;5:F1000 Faculty Rev-1530.

[11] Prepared by the International Association for the Study of Pain, Subcommittee on Taxonomy. Classification of chronic pain: descriptions of chronic pain syndromesand definitions of pain terms.. Pain Suppl. 1986;3:S1-S226.

[12] Kent PM, Keating JL. The epidemiology of low back pain in primary care.Chiropr Osteopat. 2005 Jul26;13:13.

[13] Bogduk N. On the definitions and physiology of back pain, referred pain, andradicular pain. Pain2009;147(1-3):17-9.

[14] O'Neill CW, Kurgansky ME, Derby R, Ryan DP. Disc stimulation and patternsof referred pain. Spine (Phila Pa 1976)2002;27(24):2776-81.

[15] Hirsch C, Ingelmark B, Miller M. The anatomical basis for low back pain. Studies on the presence of sensory nerve endings in ligamentous, capsular and intervertebral disc structures in the human lumbar spine. Acta Orthop Scand1963;33:1-17.

[16] Hadley L. Anatomico-roentgenographic studies of the posterior spinal articulations. Am J Roentgenol Radium Ther Nucl Med1961;86:270-6.

[17] van Kleef M, Vanelderen P, Cohen SP, Lataster A et al. Pain originating from the lumbar facet joints. Pain Pract2010;10(5):459-69.

[18] Cohen SP, Raja SN. Pathogenesis, diagnosis, and treatment of lumbarzygapophysial (facet) joint pain. Anesthesiology2007;106(3):591-614.

[19] Peh W. Image-guided facet joint injection. Biomed Imaging Interv J2011;7(1):e4.

[20] Jackson RP, Jacobs RR, Montesano PX. Facet joint injection in low-back pain: A prospective statistical study. Spine (Phila Pa 1976)1988;13(9):966-71.

[21] Beresford ZM, Kendall RW, Willick SE. Lumbar facet syndromes. Curr Sports Med Rep 2010;9(1):50-6.

[22] Deyo RA. Treatment of lumbar spinal stenosis: a balancing act. Spine J 2010;10(7):625- 7.

[23] Chad DA. Lumbar spinal stenosis. Neurol Clin2007;25(2):407-18.