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ORIGINAL RESEARCH

A prospective study for evaluation of degenerative changes in lumbar spine by MRI in Rajsamand

[1]Dr. Vishwas V Chakra, [2]Dr. Gupta Pareshkumar Mahesh Chandra

[1]Associate Professor, [2]Assistant Professor, Department of Radiodiagnosis, Ananta Institute of Medical Science and Research Center, Rajsamand, India

Corresponding author: Dr. Vishwas V Chakra
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Abstract

Background: The main objective of this study was to evaluate lumbar spine degeneration with the help of Magnetic Resonance Imaging (MRI) in an asymptomatic patient and to provide baseline data on the pattern of degeneration to understand how the lumbar spine ages.

Materials and Methods: This study was a prospective cohort study of 150 patients carried out at the Department of Radiology, Ananta Institute Of Medical Sciences, Rajsamand, Rajasthan, who underwent lumbar spine MRI for lower back pain. The scans consisted of sagittal and axial T1-weighted and T2-weighted turbo spin-echo and STIR images. The correlation between age and the pattern of lumbar spine degeneration was evaluated.

Results: The average number of degenerated disc levels significantly increased with patient's age. In the female patient's group, lumbar spine degeneration was observed in significantly older patients and those with a higher BMI than the male patients. MRI findings showed that the prevalence of various degenerative patterns was more common among male patients. Only disc herniation and canal stenosis were common among female patients; however, there was no statistically significant comparison between them.

Conclusion: The degenerative changes in the lumbar disc can appear as early as 21-40 years. Degenerative changes in the lumbar spine increase with age, being more common among male than female patients. As age advances, the prevalence of degenerative changes in multiple levels is also found. The aetiology of these changes reported explicitly in the younger age group needs to be investigated further.

Keywords: MRI, Lumbar spine, Spine degeneration, Lower back pain

Introduction

The lumbar spine region often shows the extent of degenerative changes, and these changes cause a series of pathological and musculoskeletal conditions. These degenerative changes mainly occur in an intervertebral disc with adjacent spine structures that are also compromised, which may be mainly due to the ageing process associated with certain pathophysiological conditions. Most of the individuals with lumbar spine degenerative disease conditions can be asymptomatic or symptomatic; however, this disease is generally asymptomatic [1]. The symptomatic individuals of degenerative disease may show the symptoms of lower back pain or radiculopathy pain (i.e., sciatica)[2].

The degenerative changes of the intervertebral disc are mainly characterised by decreased hydration of the nucleus pulposus, and various biochemical and mechanical factors that disrupt the annulus fibrosus. The continuous ageing process in human beings is considered one of the main causative factors for lumbar spine degenerative changes [3]. Ageing is the main causative factor implicated in spine degenerative disease. Besides ageing, many other

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factors have also been implicated as leading causes for lumbar spine degenerative disease conditions, including malnourishment, genetic, trauma history of excessive physical loading.
In recent times, it has been observed that there is more prevalence of lower back pain conditions in the younger population. To diagnose these conditions more accurately and precisely, Magnetic Resonance Imaging (MRI)- a radiological technique, is preferred. As we all know, MRI is widely used as an accurate, sensitive and non-invasive method to evaluate disc degeneration and its associated pathophysiological changes. Approximately seven in ten individuals will experience Lower Back Pain (LBP) at some point in their lives. Regarding disability, lumbar spine degeneration is ranked top among the various other conditions reviewed in a 2010 Global Burden of Disease study [1-4]. There have been continuous efforts in the diagnosis, comprehensive management and prevention of various spinal ailments [1]. Spinal cord disorders assume significant importance to human health as these ailments can pose a grave challenge to humanity. Furthermore, degenerative spine and lower back pain are the leading cause of physical disability and absence at the workplace; this causes cascading effects on the work culture and results in a tremendous economic burden to the community [5, 6].

Aims and objective

The main objectives of this present study were MRI characterisation of lumbar disc degeneration and analysis of lumbar disc degeneration patterns in patients with lower back pain, and evaluation of the extent of involvement of surrounding tissues and bones. This unique study assesses the various patterns and rates of prevalence of lumbar spine degenerations at different disc levels.

Materials and methods

Our study was a prospective study of 150 patients carried out at the Department of Radiology, Ananta Institute Of Medical Sciences, Rajsamand, Rajasthan from July 2022 to July 2023. This study included all the patients above 20 years of age who were referred to the Radiology Department for spine MRI analysis.
Sample Size: 162 patients with lower back pain were referred for spine MRI analysis, but only 150 patients fulfilled inclusion criteria; these patients were included in this study.
Institutional Ethical Committee approved this study.
Patients who already underwent spine surgery, suffering from spinal tumours, spine infection and vertebral column trauma were not considered for this study.
Patients above 20 years of age with an active history of lower back pain referred to lower spine MRI analysis was positively included in this study.
MRI Techniques: The patient was placed in the supine position in the MR gantry. Lumbar spine MRI was done using GE 1.5 Tesla HDXT scanner. The scans consisted of sagittal and axial T1-weighted (repetition time/echo time (TR/TE) of 400/8 ms) and T2-weighted (TR/TE of 3,000/120 ms) turbo spin-echo and STIR images.
Statistical analysis: The statistical analysis of research data was carried out with SPSS software.

Results

Table-1: General Demographic Characteristics of patients participated in the study

Variables	Gender

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		Male (n=81)	Female (n=69)
Age (Years)	**20-29**	11	8
	30-39	12	8
	40-49	14	11
	50-59	12	15
	60-69	14	14
	70-79	18	13
Height (cm)		168 ± 9	159 ± 6
Weight (Kg)		73 ± 11	64 ± 7
BMI (Kg/m^2)		24 ± 3.9	25 ± 5.4

Our study included 150 patients, the participant's age (years) range was from 20 to 80 years (mean age = 47 ± 16.5 years), out of 150 patients, sixty five (%) of them were female patients (Table 1). In the female patient's group, lumbar spine degenerations were observed in significantly older patients and those with a higher BMI than male patients.

Table-2: The variation and frequency distribution of spine degenerative patterns as per the imaging findings (n=150).

Variables	Disc Bulge	Disc Herniation	Nerve Root Compression	Modic Changes		Canal Stenosis
				Type I	Type II	
Number of Cases	44	79	97	3	8	69
Percentage (%)	29.33	52.7	64.7	2	5.3	46

Radiological analysis of MRI scan indicated that (Table 2)overall prevalence of lumbar degenerative findings was 93.21%, nerve root compression being the most frequent finding seen in 97(64.7%) patients, followed by disc herniation 79 (52.7%), central stenosis 69 (46%) and disc bulge 44 (29.33%). MRI analysis also highlighted that the least common finding was Modic changes seen in 11 patients (7.3%). Only very few numbers of patients (6.79%) showed normal lumbar MRI findings.

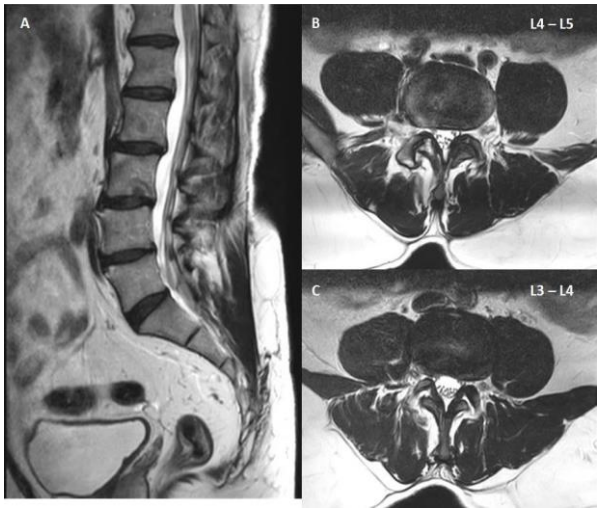

Fig-1: A 45-year-old male presented with right lower limb radiculopathy and magnetic resonance imaging lumbar spine (A) sagittal and axial view (B) L4-L5, (C) L3-L4 showing right L4-5 foraminal disc bulge.

The selected MRI representational image shows mild retrolisthesis of L2 over L3 and L3 over L4 vertebra. Diffuse L3-L4 disc bulge indenting the thecal sac narrowing bilateral lateral recesses and neural foraminae and impinging on bilateral traversing L4 nerve roots.

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Ligamentumflavum hypertrophy at this level with facet joint arthropathy.L4-L5 posterior annular tear with right far lateral disc bulge indenting the right exiting L4 nerve root. Ligamentumflavum hypertrophy at this level with facet joint arthropathy.

Table-3: The variation and frequency distribution of spine degenerative patterns as per the patient's gender

Variables	Disc Bulge (n=44)	Disc Herniation (n=79)	Nerve Root Compression (n=97)	Modic Changes		Canal Stenosis (n=69)
				Type I (n=3)	Type II (n=8)	
Male	26 (59.09%)	35 (44.30%)	59 (60.82%)	2 (66.66%)	5 (62.5%)	28 (40.57%)
Female	18 (40.99%)	44 (55.69%)	38 (39.17%)	1 (33.33%)	3 (37.5%)	41 (59.42%)

MRI findings have shown (Table 3) that the prevalence of various degenerative patterns was more common among male patients. Only disc herniation and canal stenosis were common among female patients; however, there was no statistically significant comparison. (P-value $\geq$0.05).

Table-4: The variation and frequency distribution of spine degenerative patterns as per the patients'age

Variables	Disc Bulge (n=44)	Disc Herniation (n=79)	Nerve Root Compression (n=97)	Modic Changes		Canal Stenosis (n=69)
				Type I (n=3)	Type II (n=8)	
20-29 years	4	3	6	0	1	2
	(9.09 %)	(3.79%)	(6.18%)	(0.0%)	(12.5%)	(2.89%)
30-39 years	5	14	13	1	2	8
	(11.36%)	(17.72%)	(13.40%)	(33.33%)	(25%)	(11.59%)
40-49 years	8	19	22	1	1	10
	(18.18%)	(24.05%)	(22.68%)	(3.33%)	(12.5%)	(14.49%)
50-59 years	11	23	29	0	2	17
	(25%)	(29.11%)	(29.89%)	(0.0%)	(25%)	(24.63%)
60-69 years	9	11	16	1	1	21
	(20.45%)	(13.92%)	(16.49%)	(3.33%)	(12.5%)	(30.43%)
70-79 years	7	9	11	0	1	11
	(15.90%)	(11.39%)	(11.34%)	(0.0%)	(12.5%)	(15.94%)

The MRI analysis showed that the prevalence of lumbar spine degenerative patterns was correlated with increasing age in this present study. Specifically, patients from the age group of 60-69 years and 70-79 years had multiple patterns of degenerative changes (74%) in the lumbar spine, whereas in younger age groups of patients, i.e.,20-29 years and 30-39 years, the prevalence was 39% and 56% respectively (Table 4). The same prevalence trend was also observed for Modic changes, central canal stenosis and nerve root compression. Type II Modic changes were more common than type I, with the prevalence of 5.79% and 2.17%, respectively. The other common degenerative pattern, such as disc bulge and disc herniation, had also shown the moderate prevalence in aged patients, but no statistically significant differences were observed.

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Table-5: The variation and frequency distribution of spine degenerative patterns as per the image findings at disc level.

Disc Level	Disc Bulge (n=44)	Disc Herniation (n=79)	Nerve Root Compression (n=97)	Modic Changes		Canal Stenosis (n=69)
				Type I (n=3)	Type II (n=8)	
L1/L2	2 (4.54%)	3 (3.79%)	9 (9.27%)	1 (3.33%)	1 (12.5%)	5 (7.24%)
L2/L3	5 (11.36%)	9 (11.39%)	12 (12.37%)	0 (0.0%)	2 (25%)	9 (13.04%)
L3/L4	9 (20.45%)	13 (16.45%)	19 (19.58%)	0 (0.0%)	1 (12.5%)	12 (17.39%)
L4/L5	13 (29.54%)	23 (29.11%)	23 (23.71%)	1 (3.33%)	2 (25%)	19 (27.53%)
L5/S1	15 (34.09%)	31 (39.24%)	34 (35.05%)	1 (3.33%)	2 (25%)	24 (34.78%)

MRI analysis has highlighted (Table 5) that the prevalence of the degenerative findings was seen at lower lumbar levels, i.e., L4/L5 and L5/S1. At L5/S1, most degenerative changes such as disc bulge, disc herniation, nerve root compressions, Modic changes, and central canal stenosis.

Discussion

The degenerative changes of the lumbar spine cause severe lower back pain, which is one of the most familiar causes of physical disability among working adult individuals. Therefore, the lower back pain due to the lumbar spine degeneration imparts a significant socioeconomic burden on the health care system [7].

The early diagnosis of degenerative pattern in the intervertebral disc occurs at the endplate, best visualized on Magnetic Resonance Imaging (MRI). Ours was a prospective hospital-based study that used the MRI technique to diagnose degenerative changes in lumbar spine with better tissue segregation. It can show degenerative changes early compared to other imaging techniques (such as CT scan). Other advantages of MRI include having no known side effects or morbidity, no radiation exposure and being non-invasive [8].

Radiological analysis of both sagittal and axial views of the lumbar spine MRI scan of all the recruited patients was interpreted to locate the degenerative findings. prevalence of lumbar degenerative findings was 93.21%, nerve root compression being the most frequent finding seen in 97(64.7%) patients, followed by disc herniation 79 (52.7%), central stenosis 69 (46%) and disc bulge 44 (29.33%) . MRI analysis also highlighted that the least common finding was Modic changes seen in 11 patients (7.3%). Only very few numbers of patients (6.79%) showed normal lumbar MRI findings. These findings were contrary to earlier studies, as this discrepancy in the prevalence may be attributable to the differences in diagnosis method or patient population or method [9, 10].

In agreement with previous studies [11, 12], we confirmed the correlation between the spine degeneration pattern with advancing age. The MRI analysis showed that the prevalence of lumbar spine degenerative patterns was correlated with increasing age in this present study. Specifically, patients from the age group of 60-69 years and 70-79 years had multiple patterns of degenerative changes in the lumbar spine, whereas in younger age groups of patients, i.e.,20-29 years and 30-39 years, the prevalence was 39% and 56% respectively. In our study, MRI findings showed that the prevalence of various degenerative patterns was more common among male patients. Only disc herniation and canal stenosis were common among female patients, and these observations were consistent with prior studies [13, 14]. This study highlighted that the prevalence of the degenerative findings was seen at lower

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lumbar levels, i.e., L4/L5 and L5/S1. At L5/S1, most degenerative changes such as disc bulge, disc herniation, nerve root compressions, Modic changes, and central canal stenosis were highest compared to another disc level. Our results are in corroboration with the earlier published study, which highlighted that the most typical level of disc degeneration was L4-L5, and the commonest type was disc protrusion [11-15]. This suggests that disc degeneration is a cyclical process; if it affects a disc at one level, this may also lead to disc degeneration at adjacent levels by changing its mechanical load.

Our study has a few limitations as this study was a prospective study and not a longitudinal study. Longitudinal types of studies will be necessary to elucidate the pattern of degeneration more accurately. Despite this limitation, our study presents valuable data on the natural pattern of spine degeneration in symptomatic patients. Our goal in this lumbar spine degenerative changes analysis was to gather preliminary data to prompt further epidemiological studies into degenerative lumbar spine disease with or without surgical intervention.

Conclusion

The study reveals the prevalence of lumbar spine degeneration and its natural pattern in symptomatic patients. There is a strong association between low back pain patients and degenerative changes in the lumbar spine observed on MRI. Degenerative changes in the lumbar spine increase with age, being more common among males than females. The intervertebral disc degeneration is most common in the region of lower lumbar level L4/L5 and contiguously progresses to adjacent levels, i.e., L5/S1. This disc degeneration pattern may affect the development of adjacent level disc degeneration.

References

1. Chen, L., Perera, R.S., Radojcic, M.R., Beckenkamp, P.R., Ferreira, P.H., Hart, D.J., Spector, T.D., Arden, N.K., Ferreira, M.L. (2021). Association of Lumbar Spine Radiographic Changes with Severity of Back Pain-Related Disability among Middle-aged, CommunityDwelling Women. JAMA Netw Open. 2021 May 3;4(5):e2110715. doi: 10.1001/jamanetworkopen.2021.10715. PMID: 34014327; PMCID: PMC8138688.
2. Ravindra, V.M., Senglaub, S.S., Rattani, A., Dewan, M.C., Härtl, R., Bisson, E., Park K.B., Shrime, M.G. (2018). Degenerative Lumbar Spine Disease: Estimating Global Incidence and Worldwide Volume. Global Spine J. Dec;8(8):784- 794. doi: 10.1177/2192568218770769.
3. Chhabra, H.S. (2019). Rising to the challenge: Spinal ailments in India. Indian J Orthop, 53; 489- 92. 4. GBD. (2017). Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018;392(10159):1789-1858. doi:10. 1016/S0140-6736(18)32279-7 2.
4. Hartvigsen, J., Hancock, M.J., Kongsted, A. (2018). Lancet Low Back Pain Series Working Group. What low back pain is and why we need to pay attention. Lancet. 391(10137):2356-2367. doi:10.1016/S0140-6736(18)30480-X.
5. Downie, A., Hancock, M., Jenkins, H. (2020). How common is imaging for low back pain in primary and emergency care? systematic review and metaanalysis of over 4 million imaging requests across 21 years. Br J Sports Med, 54(11):642-651. doi:10.1136/bjsports-2018-100087.
6. Parenteau, C.S., Lau, E.C., Campbell, I.C. (2021). Prevalence of spine degeneration diagnosis by type, age, gender, and obesity using Medicare data. Sci Rep, 11, 5389. https://doi.org/10.1038/s41598-021- 84724-6

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

7. Foster, N.E., Anema, J.R., Cherkin, D. (2018). Lancet Low Back Pain Series Working Group. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet, 391(10137):2368-2383. doi:10. 1016/S0140-6736(18)30489-6.
8. Kushchayev, S.V., Glushko, T., Jarraya, M. (2018). ABCs of the degenerative spine. Insights Imaging, 9(2):253-274. doi:10.1007/s13244-017-0584-z.
9. Walwante, R.D., Dhapate, S.S., Porwal, S. S. (2017). Evaluation of degenerative changes in lumbar spine by MRI in rural population. MedPulse – International Journal of Anatomy, 3(1); 25-29.
10. Ravikanth, R. (2020). Magnetic Resonance Evaluation of Lumbar Disc Degenerative Disease as an Implication of Low Back Pain: A Prospective Analysis. Neurol India, 68; 1378-84.
11. Song, Q., Liu, X., Chen, D.J., Lai, Q., Tang, B., Zhang, B., Dai, M., Wan, Z. (2019). Evaluation of MRI and CT parameters to analyze the correlation between disc and facet joint degeneration in the lumbar three-joint complex. Medicine, 98:40(e17336).
12. Yu, L.P., Qian, W.W., Yin, G.Y., Ren, Y.X., Hu, Z.Y. (2012). MRI Assessment of Lumbar Intervertebral Disc Degeneration with Lumbar Degenerative Disease Using the Pfirrmann Grading Systems. PLoS ONE, 7(12): e48074. doi:10.1371/journal.pone.0048074.
13. Like, M., Solovieva, S., Lamminen, A., Luoma, K., Leino-Arjas, P., Luukkonen, R., Riihimäki, H. (2005). Disc degeneration of the lumbar spine in relation to overweight. Int J Obes (Lond), Aug;29(8):903-8. doi: 10.1038/sj.ijo.0802974.
14. Suzuki, A., Daubs, M.D., Hayashi, T. (2017). Magnetic resonance classification system of cervical intervertebral disc degeneration: its validity and meaning. Clin Spine Surg, 30(5); E547-E553.