Medical Science

pISSN 2321–7359; eISSN 2321–7367

Prevalence of MRI findings in lumbosacral spine in patients with chronic low back pain: A cross-sectional study

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To Cite:
Almushayti Z, Alamer A, Alduraib S, Aldhilan A, Alharbi B, Alammari M, Almutairi M, Alfadda T, Almushayti M. Prevalence of MRI findings in lumbosacral spine in patients with chronic low back pain: A cross-sectional study. Medical Science, 2022, 26, ms33e2053.
doi: https://doi.org/10.54905/disssi/v26i119/ms33e2053

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Peer-Review History
Received: 23 December 2021
Reviewed & Revised: 25/December/2021 to 13/January/2022
Accepted: 14 January 2022
Published: 16 January 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Introduction: Low back pain (LBP) is one of the most common causes of patients looking for medical care. The incidence of LBP in adults is 84% and the estimated incidence in all age groups is 18%. *Materials and Methods*: A cross-sectional study conducted among patients who underwent lumbosacral spine MRI for suspected degenerative disc diseases causing chronic low back pain in patients who age from 21 to 73 years between January 2019 and August 2021. *Results*: 427 patients fit into our inclusion criteria. The most common MRI degenerative finding was disc dehydration (82%) followed by the effect on the relative nerve roots including touching, encroachment, and compression (78.7%) while annular fissure was the least (4.9%). *Conclusion*: Disc dehydration was the most common pattern of MRI degenerative findings and its prevalence was higher among the elderly. The most commonly affected region of the spine was L4/5 with similar prevalence in both males and females.

Keywords: Low back pain, MRI, degenerative disc disease

1. INTRODUCTION

Low back pain (LBP) is an ordinary cause of individuals seeking medical care (Burton et al., 2006). According to the Global Burden of Disease 2010 Study, lower back pain causes more global disability than any other condition (Murray et al., 2010). Having a lower backache is a major health issue with a huge economic impact on communities. It not only increases the cost of healthcare, but it also increases disability and loss of productivity in the general population (Rahyussalim et al., 2020). In adults, the reported incidence of low back pain is 84%, with an estimated incidence of 18% in all age groups at any given time (Andersson, 1999; Balagué et al., 2012). Furthermore, 8 out of 10 people will suffer from LBP in their lifetime (Mooney, 1976).

The most widely recognized reason for the pain is the degenerative state of intervertebral discs (Almushayti et al., 2021), which leads to disc-root interference, although numerous structural intersegmental spine changes may also have been responsible for causing patients' signs and symptoms. A degenerative disease of the spine is prevalent in the general population, and with aging, its incidence increases. Among those individuals, pain is the most frequently reported symptom; neurologic conditions are also associated with this pathology (D'Aprile et al., 2018). There have been studies that find that degenerative changes can occur in asymptomatic people as well (Boden et al., 1990; Jensen et al., 1994). However, the likelihood of having degenerative changes is greater in symptomatic individuals (Luoma et al., 2000). Different factors can lead to degenerative processes of the spine, such as mechanical (eg. postural defects, excess weight bearing, sports), anatomical (eg. malformations, dysplasia), and metabolic (eg. diabetes) (Battié et al., 1995; Cappabianca et al., 2008).

Men are more affected by disc degeneration than women (Suthar et al., 2015). The level of disc involvement varies from person to person. Annular disc tear, disc herniation, disc extrusion, narrowing of the spinal canal, narrowing of lateral recess, compression of neural foramen, facet arthropathy and ligamentum flavum thickening is common at the L4 -L5 disc level. Spondylolisthesis and involvement of the L1-L2 discs are less common (Suthar et al., 2015; Ravikanth et al., 2020). MRI is the gold standard for evaluating lumbar disc degeneration (LDD). In addition to the ability of MRI to evaluate LDD, it also yields information that is needed for accurate and reliable classification of the severity of LDD (Pfirrmann et al., 2001). MRI is a significant advantage because it does not expose patients to an ionizing radiation and has good visualization capabilities, especially for soft tissues. Thus, it is considered the most reliable method for detecting disc abnormalities (Jarvik & Deyo, 2002).

The study's objectives are to evaluate the prevalence of pathological MRI findings in patients undergoing MRI spine for chronic low back pain and the relationship between lumbar degenerative diseases with age, sex and their MRI findings. Furthermore, we assess the most common findings and their involvement levels in our region.

2. MATERIALS & METHODS

Case selection

A cross-sectional study was performed on a total number of 427 patients; 294 males (68.85%) and 133 females (31.15%) with ages ranging from 21 to 73 years old. The study was done in the Qassim region at a secondary hospital in Buraydah, Saudi Arabia. We included patients who underwent MRI lumbar spine imaging for suspected degenerative disc diseases causing chronic low back pain between January 2019 and August 2021. Oral and written informed consent was obtained from participants. Inclusion and exclusion criteria are shown in table 1.

Table 1 Inclusion and Exclusion criteria

Inclusion criteria
Age from 21 to 73 years
Patients underwent MRI for suspected degenerative disc diseases
Chronic low back pain (more than 12 weeks)
Exclusion criteria
Acute low back pain
History of trauma
Known primary malignancy

Image analysis

The MRI images were evaluated by four consultant radiologists (Z.A 13 years' experience in neuroradiology, A.A 10 years' experience in neuroradiology, A.S 10 years in MSK and S.K 8 years in body/women imaging) for the presence of any MRI findings related to degenerative spine changes. Our study classified the participants according to gender and age groups as follows; less than or equal to 40 years or more than 40 years.

MRI parameters

A 1.5 Tesla magnet (general electronic) was used as an examination tool. The sequences that were obtained are T1 weighted image (T1WI) and T2 weighted image (T2WI) in both axial and sagittal planes. Also, Short TI Inversion Recovery (STIR) in the sagittal

plane and coronal plane T2WI sequences were performed. Descriptive statistics were presented using numbers and percentages (%). Between comparisons, chi-square tests were applied. A p-value of ≤0.05 (two-sided) was used to indicate statistical significance. All data analyses were performed using the Statistical Packages for Software Sciences (SPSS) version 26 (Armonk, New York, IBM Corporation).

3. RESULTS

We reviewed 427 cases with back pain that is chronic (male: 294 vs female: 133). The most common age group was more than 40 years old (59%). L4/5 was identified as the worse level (54.1%) followed by L5/S1 (34.4%). The prevalence of disc dehydration was 82% and the prevalence was significantly higher in males (p=0.001) (Table 2).

Table 2 Baseline attributes of the patients with ongoing persistent lower backache

Study variables	Overall N (%) (n=427)	Male N (%) (n=294)	Female N (%) (n=133)	P-value §
Age in years				
≤40 years	175 (41.0%)	119 (40.5%)	56 (42.1%)	0.751
>40 years	252 (59.0%)	175 (59.5%)	77 (57.9%)	
Worse level				
L4/5	231 (54.1%)	168 (57.1%)	63 (47.4%)	
L5/S1	147 (34.4%)	98 (33.3%)	49 (36.8%)	0.079
L3/4	49 (11.5%)	28 (09.5%)	21 (15.8%)	

§ P-value has been calculated using Chi-square test.

** Significant at p=0.05 level.

Figure 1 showed the various MRI findings. It can be observed that the most common MRI finding was disc dehydration (82%), followed by the effect on the relative nerve roots including touching, encroachment, and compression (78.7%), next was narrowing of the neural foramen (70.5%), disc bulge (55.7%), and straightening (54.1%) while the least of them was annular fissure (4.9%).

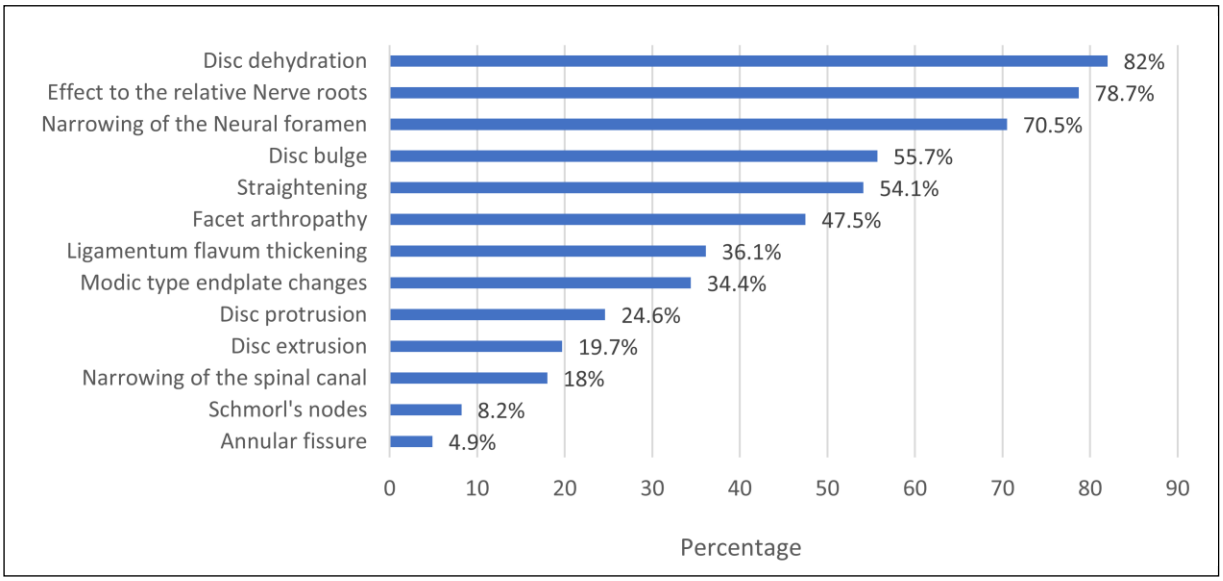

Figure 1 MRI findings

In table 3, we compared the MRI findings between males and females. It revealed that the prevalence of narrowing of the neural foramen (p<0.001), straightening (p<0.001), Ligamentum Flavum thickening (p<0.001), Modic type endplate changes (p=0.018), spinal canal stenosis (p<0.001) and annular fissure (p=0.002) were significantly more in males. Other MRI findings were not

significantly different between males and females including disc dehydration, effect on the relative nerve roots, disk bulge, facet arthropathy, disk protrusion, disc extrusion and Schomorl's nodes (p>0.05).

Table 3 MRI findings in accordance to gender (n=427)

MRI Findings	N	Male N (%) (n=294)	Female N (%) (n=133)	P-value §
Disc dehydration	350	245 (83.3%)	105 (78.9%)	0.275
Effect to the relative Nerve roots	336	238 (81.0%)	98 (73.7%)	0.089
Narrowing of the Neural foramen	301	224 (76.2%)	77 (57.9%)	<0.001 **
Disc bulge	238	161 (54.8%)	77 (57.9%)	0.546
Straightening	231	182 (61.9%)	49 (36.8%)	<0.001 **
Facet arthropathy	203	147 (50.0%)	56 (42.1%)	0.130
Ligamentum flavum thickening	154	133 (45.2%)	21 (15.8%)	<0.001 **
Modic type endplate changes	147	112 (38.1%)	35 (26.3%)	0.018 **
Disc protrusion	105	77 (26.2%)	28 (21.1%)	0.254
Disc extrusion	84	56 (19.0%)	28 (21.1%)	0.629
Spinal canal stenosis	77	70 (23.8%)	07 (05.3%)	<0.001 **
Schmorl's nodes	35	28 (09.5%)	07 (05.3%)	0.137
Annular fissure	21	21 (07.1%)	0	0.002 **

§ P-value has been calculated using Chi-square test.

** Significant at p=0.05 level.

We also compared MRI findings between age groups (≤40 years vs >40 years). It was observed that disc dehydration (p<0.001), effect on the relative nerve roots (p<0.001), narrowing of the neural foramen (p<0.001), straightening (p<0.001), facet arthropathy (p<0.001) Ligamentum Flavum thickening (p<0.001), Modic type endplate changes (p<0.001), disc extrusion (p<0.001), spinal canal stenosis (p<0.001), Schmorl's nodes (p=0.008) and annular fissure (p<0.001) were more common in patients who were more than 40 years old while disc protrusion was more common in patients who are not more than 40 years old (p=0.009) (Table 4).

Table 4 MRI findings in accordance to age group (≤40 years vs >40 years) (n=427)

MRI Findings	N	Age ≤40 years N (%) (n=238)	Age >40 years N (%) (n=189)	P-value §
Disc dehydration	350	105 (60.0%)	245 (97.2%)	<0.001 **
Effect to the relative Nerve roots	336	105 (60.0%)	231 (91.7%)	<0.001 **
Narrowing of the Neural foramen	301	91 (52.0%)	210 (83.3%)	<0.001 **
Disc bulge	238	140 (58.8%)	98 (51.9%)	0.150
Straightening	231	70 (40.0%)	161 (63.9%)	<0.001 **
Facet arthropathy	203	28 (16.0%)	175 (69.4%)	<0.001 **
Ligamentum flavum thickening	154	28 (16.0%)	126 (50.0%)	<0.001 **
Modic type endplate changes	147	21 (12.0%)	126 (50.0%)	<0.001 **
Disc protrusion	105	70 (29.4%)	35 (18.5%)	0.009 **
Disc extrusion	84	28 (11.8%)	56 (29.6%)	<0.001 **
Spinal canal stenosis	77	07 (04.0%)	70 (27.8%)	<0.001 **
Schmorl's nodes	35	07 (04.0%)	28 (11.1%)	0.008 **
Annular fissure	21	0	21 (08.3%)	<0.001 **

§ P-value has been calculated using Chi-square test.

** Significant at p=0.05 level.

4. DISCUSSION

The present study examined the prevalence of MRI degenerative findings in the lumbosacral spine of patients with back pain that is persistent. The most common MRI degenerative finding was disc dehydration (82%). This finding is consistent with the paper by Kaanan et al., (2020) according to their findings; disc dehydration was the most common MRI finding, while spondylolisthesis was the least common. In our study, annular fissure was the least frequent lumbosacral spine problem detected by the MRI. Similarly, Rai et al., (2016) reported desiccation of disc as the most common degenerative finding, followed by the disc bulge, hypertrophy of the ligamentum flavum, hypertrophy of facet joint, herniated disc, spinal canal narrowing,, osteophytes and Modic changes. Likewise, Sharma et al., (2018) indicated that the most common MRI findings among patients with persistent low back pain were disc signal change (83.3%), followed by disc bulge (77.8%), foraminal narrowing (76.9%) while the least of them was endplate change (15.7%). In Iraq, it has been reported that the most common degenerative outcome was degenerative disc disease, followed by disc herniation, facet joint hypertrophy, spondylolisthesis, HIZ, Schmoral nodules and Modic changes (Bakr et al., 2019). However, in Czech Republic, the most well known finding of patients with non-specific chronic low back pain was disc bulge (61.5%), followed by disc protrusion (40.4%) and Modic changes (32.7%) (Vagaska et al., 2019); in our study, the effect on the relative nerve roots was the second most common degenerative finding (78.7%), next was narrowing of the neural foramen (70.5%), disc bulge (55.7%) and straightening (54.1%). Other lumbosacral spine problems include; facet arthropathy (47.5%), Ligamentum Flavum thickening (36.1%), Modic type endplate changes (34.4%) disc protrusion (24.6%), disc extrusion (19.7%),spinal canal narrowing (18%) and Schmorl's nodes (8.2%).

It can be observed that the prevalence of patients with pathological MRI findings was more common in males than females. These include; narrowing of the neural foramen ($p<0.001$), straightening, Ligamentum Flavum thickening ($p<0.001$), Modic type endplate changes ($p=0.018$), spinal canal narrowing ($p<0.001$) and annular fissure ($p=0.002$). Incidentally, in a paper done by Kaanan et al., (2020) they found that disc protrusion had significantly low prevalence in the female group ($p=0.012$). In our study, the prevalence of disc protrusion among males and females showed no significant differences ($p=0.254$) which did not coincide with previous reports. Moreover, when we examined the differences in MRI findings between age groups (≤40 years vs >40 years), we noticed that most of the lumbosacral spine problems were associated with the older age group including disc dehydration, effect to the relative nerve roots narrowing of the neural foramen, straightening, facet arthropathy, Ligamentum Flavum thickening, Modic type endplate changes, disc extrusion, spinal canal stenosis and annular fissure. Only disc protrusion was associated with the younger age group. Incidentally, in a paper published by Abubakar et al., (2017) they found that lumbar spondylosis is the most common pattern detected by MRI in male patients in the 41 - 50 years old group with the lesion mostly seen on L4/L5 vertebrae of the spine.

Conversely, the data in this study confirmed a general trend to more frequent and more assertive degenerative changes in the lumbosacral spine segments specifically at L4/5 and L5/S1 levels with a slight difference of degeneration at the L4/5 level than L5/S1 portions. This is similarly reported with other studies where L4/5 and L5/S1 had been ascertained as the most regularly impacted levels of the spine (Cheung et al., 2009; Suri et al., 2013; Määttä et al., 2015; Mok et al., 2016; Farshad-Amacker et al., 2017; Rajasekaran et al., 2008). Furthermore, we also noted that 82% of the patients demonstrated disc dehydration and the incidence rate was higher in males than females ($p=0.001$).

Limitations and Clinical correlations

The study may have some limitations, such as patients who have metallic hardware for whom an MRI scan is contraindicated, insufficient MRI machines, and being an expensive test, as well as some patients who refused to undergo MRI. We recommend further studies on this subject with a more sample size and involving several regions in Saudi Arabia. Our study allows us to map common findings on lumbosacral spine MRI in our region for better management and prevention, bringing attention to the younger population that could be affected by degenerative disc disease and offering a suggestion to look for incidental findings in lumbosacral spine MRI for degenerative disc disease patients. We believe that the treating physicians in our region ought to know about the prevalence of common MRI findings in chronic low back pain patients, as observed in our study.

5. CONCLUSION

The most common pattern of MRI degenerative findings was disc dehydration and its prevalence was higher in the older population. L4/5 was the most commonly affected region of the spine with similar prevalence in both males and females. This research also generalized that the prevalence of MRI degenerative findings was more common in older males.

Ethical approval

Ethical approval was taken from Ministry of Health, Qassim Regional Research Ethics Committee, Registered at National Committee of Bio & Med. Ethics (NCBE) Registration No. H-04-Q-001. Ethical approval number 1443-810725, dated Monday, December 6, 2021.

Consent

Oral and written informed consent was obtained from all participants.

Author's Contributions

Zyiad Almushayti (ZA), Ali Alamer (AA), was responsible for the conceit of the research idea and the study design. Sharifa Alduraibi (SD), Asim Aldhilan (AD), Bader Alharbi (BH), was responsible for the concept and design, data analysis and interpretation, and the initial draft of the manuscript. Mohammed Alammari (MA), Majed Almutairi (MM), Turky Alfadda (TF), Mohammed Almushayti (MM), is contributed to writing the methods section, data collection and critical review of the manuscript draft.

Funding

The study did not receive any external funding

Conflict of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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