

**Original Research**

## MRI Evaluation of Disc Lesions Causing Lumbar Canal Stenosis and Backache

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### ABSTRACT

Degenerative disease of the lumbar spine refers to a syndrome in which an intervertebral disc with adjacent spine structures is compromised, this can be due to aging process associated with pathology. Thirty five percent of asymptomatic individuals may have degenerative spine findings, including: disc degeneration, modic changes, disc bulges, facet joint arthropathy and spinal stenosis. Plain radiography provides only limited diagnostic information. It cannot show the structural morphology of the intervertebral disc. Magnetic resonance imaging (MRI) is helpful in detecting changes like disc displacement (bulge, protrusion, extrusion, sequestration), OPLL, zygapophyseal joint hypertrophy, buckling or hypertrophy of ligaments. Also MRI is helpful in differentiating central canal stenosis from lateral canal stenosis. Study population included all patients above 20 years of age with LBP with/without radiculopathy who were referred for lumbar spine MRI at Radiology Department, SRMCH from August 2011 to September 2013. All consented patients with LBP with/without radiculopathy referred for lumbar MRI were consecutively included in the study. A total of 280 individuals had lumbar MRI scan from August 2011 to September 2013, but only 250 whom fulfilled the study criterion were studied.

**Keywords:** Disc bulge, Disc dessication, Modic changes, Central canal stenosis, Lateral canal stenosis, MRI, Spine degenerative disease

### INTRODUCTION

#### Causes of Spined's:

#### Disc Degeneration

Disc degeneration is a loss of disc signal on T2W images with/without disc height reduction. The dark signal of the disc on T2W images is due to loss of water content. Initially there is biochemical within a disc, resulting in dehydration of disc. In later stages of the disease morphological changes such as loss of disc height, annular tears, rim lesions and osteophyte formation materialise. The occurrence of annular tears leads weakening of the annulus fibrosus hence disc displacement beyond the vertebral margins.

#### Modic Changes

Modic changes are endplate degenerative changes due to disc degenerative disease. These are signal intensity changes shown adjacent to the endplates of the degenerated intervertebral discs in magnetic resonance imaging (MRI). They are assumed to be a specific phenotype of degenerative disc disease. These Modic changes can be painful – especially type I changes.

They are common observation on MR images and are of three main forms. Type I is the acute stage of disc disease, there is invasion of the cancellous spaces by fibrovascular reactive tissue. With time, fatty replacement of red marrow occurs leading to type II

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Modic changes; eventually bony sclerosis of the marrow occurs and leads to type III Modic changes.

### Disc Displacement

Disc displacement is also one of the findings in spine degenerative disease. The displaced disc can be a simple bulge, protruded, extruded or sequestration (6).

- (a) Disc bulge: is a circumferential enlargement of the disc contour in a symmetric fashion in a weakened disc, the annulus is intact with disc extension outward involving >50% of disc circumference or diffuse (non focal, no osseous material extending beyond the normal disc space in a circumferential manner.
- (b) Disc herniation: 'is a localised/focal displacement of disc beyond the intervertebral disc space'(15). A herniated disc can be protruded, extruded or sequestered.
- (c) Disc protrusion: is a focal displacement disc material beyond margins of adjacent vertebral endplates involving <50% of disc circumference.
- (d) Extrusion: is a herniated disc in which, has a small connection with the parent disc (narrow neck).
- (e) Sequestration (free disc fragment): is a piece of disc tissue belonging to the disc material, moving separately from and having no connection with the main disc, migrating within the spinal cavity.

Plain radiography provides only limited diagnostic information because it cannot show the structural morphology of the intervertebral disc. Disc herniation cannot be seen on plain x-rays. However other degenerative joint disease findings, for example, narrowing of disc space, spurring, eburation and vacuum sign can be clearly seen on plain radiography. These findings can be found in patients with or without disc herniation.

## MATERIALS AND METHODS

### Study Design

This is a hospital based cross-sectional descriptive study conducted from August 2011 to September 2013.

### Study Population and Study Area

Study population included all patients above 20 years of age with LBP with/without radiculopathy who were referred for lumbar spine MRI at Radiology Department, SRMCH from August 2011 to September 2013. SRMCH is largest referral and teaching hospital in Nandyal. It is the only public/government hospital with MRI facility. It receives referred patients from all referral hospitals, as well as patients from various hospitals in Nandyal and its surrounding regions.

### Sampling and Sample Size

All consented patients with LBP with/without radiculopathy referred for lumbar MRI were consecutively included in the study<sup>[2]</sup>. A total of 280 individuals had lumbar MRI scan from August 2011 to September 2013, but only 250 whom fulfilled the study criterion were studied.

### Inclusion Criteria

Patient above 20 years of age, with history of low back pain with/without radiculopathy, plus lumbar spine degenerative imaging findings were studied.

### Exclusion Criteria

Thirty patients who had history of former lumbar spine surgery were excluded from the study.

## DISCUSSION

The role of diagnostic imaging is to provide accurate anatomic information and to affect the management and decision making. This cross-sectional hospital based study used MRI to diagnose spinal canal stenosis and spine degenerative changes as it has better tissue segregation and it can show degenerative changes at an early stage as 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 are non-invasive.

Despite its high sensitivity, degenerative changes are observed on many MRI scans in asymptomatic

subjects, thus questioning its specificity. That is why MRI is only beneficial to patients with chronic disease and those who are being planned for spine surgery. All recruited patients (250 individuals who attended SRMC GH, Nandyal) underwent MRI of the lumbar spine and both sagittal and axial T1, T2, GRE and myelography images were interpreted to locate the degenerative findings and spinal canal stenosis<sup>[9]</sup>.

Lumbar spinal canal stenosis was seen in 60 (24%). More commonly it was seen in age group 40–50 years (29.4%). The most common cause for pressure on Thecal sac in our study was due to degenerative changes. Lateral canal stenosis was seen in 193 (77.2%) in whom the major cause again was degenerative change. The most common cause of central canal stenosis and lateral canal stenosis in our study was due to degenerative changes (80% and 77%) while next common cause was due to infections etiology (13.3% and 18%) followed by trauma (6.6% and 4.1%), respectively. Disc degeneration (protrusion and herniation) was the most common cause of central canal stenosis followed by zygapophyseal joint arthritis while listhesis and OPLL were also causative factors among few individuals. Articular process hypertrophy and pedicular kinking were the most common causes for lateral canal stenosis while osteophytes impingement was also one of the causative factors in minor group of people in our study. Degenerative changes were observed in majority 239 (95.6%) of patients examined. Most of these degenerative findings were seen at L4–L5 (47.6%) and L5–S1 (53.6%) Though a degenerative change of the disc begins early in life and is partly a consequence of aging, the actual cause is not known but many factors (autoimmune, genetic, reabsorption and biochemical) have been implicated in accelerating the process<sup>[3]</sup>. Since lumbar spine is subjected to heavy mechanical stress, it is a common area affected by degenerative changes 19 this could partly explain such observation in this study group. The mean age of this study group is 50 + 12.5 years, could be another explanation, as degenerative changes are common in individuals above 40 years of

age and its prevalence increases progressively to over 90% by 50 to 55 years of age.

Disc degeneration was the most frequent finding observed in patients in this study. The prevalence was observed to increase with age. The difference observed between the age groups was significant compares well to the findings of other previous studies. The prevalence of disc degeneration to young individuals (20 to 39 years) could probably be explained as a result of genetic predisposition; though, other factors like repeated traumatic injuries and physical loading history can play a role in causing disc degeneration. The difference in prevalence among young and aged individual could be contributed by aging process. Disc degeneration was slightly more frequent among males 133 (53.2%) as compared to females 117 (46.8%), though the variation observed was not statistically significant. This is similar to the findings reported by Tarakad *et al.* (2008).

**Disc degeneration**

	Male (%)	Female (%)
Tarakad <i>et al.</i> study	55.4	44.6
Present study	53.2	46.8

Proportion of degenerated discs (reduction in disc signal intensity) progressively increases the lower the spine level and that most common spine levels were L4/L5 and 41 L5/S1, is similar to what was observed in this study. At L1/L2 level, 88% of the discs had normal signal intensity, which then progressively decreased to 38% at L4/L5 level; this finding is similar to previous report by Ong *et al.*<sup>[8]</sup>.

**Proportion of degenerated discs**

	Male (%)	Female (%)
Ong <i>et al.</i> study	81	38
Present study	88	38

The observation that disc degeneration was not associated with LBP, is similar to the findings from previous report by Sivas *et al.*<sup>[10]</sup>, however, Cheung *et al.*<sup>[11]</sup> reported a significant association of lumbar disc

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degeneration on MRI with back pain. The prevalence of Modic changes (33.6%) was higher compared to 23% found by Kuisma *et al.*<sup>[1]</sup>, and lower than prevalence of 43% found by Jensen *et al.*<sup>[5]</sup>. Modic changes in this study increased with age, 27.5%, 37.6% and 38.5% in the age group of 20 to 39 years, 40 to 59 years and 60 to 80 years, respectively, and this finding was and this is similar to the findings by Kuisma *et al.*<sup>[1]</sup>. This variation can be due to normal aging process in older individuals. In young individuals Modic changes are not uncommon; this was observed by Takatalo *et al.*<sup>[12]</sup> and Sivas *et al.*<sup>[10]</sup> to be 1.4% and 3.7%, respectively. The higher prevalence of 27.5% was observed in 20 to 39 years age group in this study, this could be due to inclusion of patient with 31–39 years in this age group. Type II Modic changes were more common than type I with prevalence of 22% and 6%, respectively. This is similar to what was found by Kuisma *et al.*<sup>[1]</sup>.

In this study, it was observed that Modic changes progressively increased the lower the spine level and the most common location were L4/L5 and L5/S1. This observation is consistent with previous studies by Kuisma *et al.*<sup>[1]</sup> and Tayone *et al.* (1994). Modic changes are associated with LBP, but may be present in individuals without LBP. In this study, Modic changes were more common in patients with LBP with radiculopathy as compared to those with LBP only. This can be due to the reason that majority (80%) of patients in this study had LBP with radiculopathy compared to only 20% with LBP only.

Disc displacement is also a common finding in lumbar spine degenerative disease. The displaced disc can be just a simple bulge or herniation; herniated discs can be protrusion, extrusion or sequestration. In this study disc bulge were more common than herniation (44.8%, 8.4%, respectively) similar to the findings reported by Sivas *et al.*<sup>[10]</sup> and Ong *et al.*<sup>[8]</sup>.

Disc bulges were more common among individuals aged 60–80 years (51.3%) as compared to individuals aged 20–39 years (46.1%), disc herniation was also

#### Disc bulge disc herniation

	Male (%)	Female (%)
Sivas <i>et al.</i> study	25.9	6.25
Ong <i>et al.</i> study	42	16
Present study	44.8	8.4

higher among older individuals. In this study, no significant difference in sex was found in the prevalence of disc bulges and herniations.

Various studies have reported that disc herniation is common at L4/L5 and L5/S1 and the frequency at these levels is ranging from 30% to over 90%<sup>[7]</sup>. This was also reflected in this study as 80% of the herniated discs were at L4/L5 and L5/S1, this can be due to the large work load causing stress at these lower lumbar levels of the spine. Disc herniation at L3/L4 and L1/L2 was observed in 10% and 4.3%, respectively, this trend is similar to previous reports.

The most location for disc herniation was posterolateral, seen in 75%, followed by posterocentral and foraminal 24%, 2%, respectively; this finding is similar to previous report.

The intraspinal disc herniation (postcentral and posterolateral) were the most common (98%), and this is similar to the findings seen by Takarad *et al.*<sup>[13]</sup>.

Sixty (24%) patients in this study had central canal stenosis, which is higher compared to that reported by Modic *et al.*<sup>[14]</sup> and Shobeir *et al.*<sup>[15]</sup>. This difference could be due to much older study population and ethnicity in this study. The common age for canal stenosis presentation is between 30 and 50 years. In this study canal stenosis was common in older patients (16.7%, 27.4% 28.2% in age groups 20 to 39 years, 40–59 and 60 to 80 years, respectively), both sexes were equally affected. Canal stenosis was frequent at L4/L5 (13.6%) and L5/S1 (12.4%), while (2.4%) was found at L1/L2 level, these findings are similar to other previous studies 20, 28.

Degenerative spinal stenosis is more common in patients with sciatica than in patients with low back

pain 6, 20. In this study the prevalence of canal stenosis among patients with radiculopathy was 38% and none was found among patients with LBP only<sup>[4]</sup>. The small canal in patients with stenosis causes thecal sac or nerve roots to impinge against the spine bone elements hence causing radiculopathy and activity dependent pain.

Nerve root compression is the most common among sciatic patients, and lower among patients with LBP. In this study prevalence of nerve root compression was 77.2%, and it increased with age being 69.6% and 76.9% in 20 to 39 and 60 to 80 years of age, respectively. Males were slightly more affected than females, prevalence being 45.6% and 31.6%, respectively, though the results were not statistically significant.

Shobeir *et al.* (2009) reported nerve root compression to be more frequent at level L5/S1, which is different from this study in which L4/L5 was the common site. However, only 4% of patients had nerve root compression at L1/L2 level.

## CONCLUSION

95.6% of studied patients had lumbar degenerative imaging findings. Disc degeneration was the most frequent finding followed by nerve root compression. The least finding was modic changes, whereby type II was more common than type I. Disc protrusion was the most common type of herniation and was commonly located poster laterally.

Lumbar central canal stenosis was found in 60 individuals (24%) of the total study population. It was more common in age group 40–59 years (32%).

Prevalence of central canal stenosis was less than lateral canal stenosis 24% and 77.2%, respectively. The incidence increased with age.

The incidence of central canal stenosis and lateral canal stenosis were more common in males 12.4% and 45.6% than in females 11.6% and 31.6% female, respectively. These findings were opposite in age group >60 years

where 33.3% in this group had stenosis while only 20% males had it.

Central canal stenosis and lateral canal stenosis were more common at L4–L5 (13.6% and 47.6%) and L5–S1 (12.4% and 40%) levels, least common at L1–L2 (2.4% and 4%) levels, respectively.

The most common cause of central canal stenosis and lateral canal stenosis in our study was due to degenerative changes (80% and 77%) while next common cause was due to infections etiology (13.3% and 18%) followed by trauma (6.6% and 4.1%), respectively.

Disc degeneration (protrusion and herniation) was the most common cause of central canal stenosis followed by zygapophyseal joint arthritis while listhesis and OPLL were also causative factors among few individuals.

Articular process hypertrophy and pedicular kinking were the most common causes for lateral canal stenosis while osteophytes impingement was also one of the causative factors in minor group of people in our study.

Central canal stenosis, disc herniation and nerve root compression were common in patients who presented with LBP with radiculopathy. These radiological findings should receive more emphasis during the interpretation of MR images of patients who present with radiculopathy, especially when their symptoms have become chronic.

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