Evaluation and Grading of Degenerative Changes of Cervical Spine Using Magnetic Resonance Imaging (MRI)

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Abstract: ***Background**: Cervical spine degeneration is a common age-related condition involving progressive changes in intervertebral discs, vertebral endplates, facet joints, and surrounding structures. Magnetic resonance imaging (MRI) provides comprehensive evaluation of these changes and their effects on neural elements. Objectives: To evaluate and grade degenerative changes of the cervical spine using MRI and to analyze their distribution across cervical levels in symptomatic patients. **Materials and Methods**: The cross-sectional observational study was conducted in the Department of Radio-Diagnosis, at a tertiary care teaching hospital over 18 months. 100 symptomatic patients presenting with neck pain, stiffness, back pain, or muscle weakness underwent cervical spine MRI on a 1.5-T scanner. Degenerative changes including disc degeneration, disc protrusion, disc space narrowing, foraminal stenosis, osteophyte formation, and Modic endplate changes were assessed. Disc degeneration was graded using the Suzuki classification, foraminal stenosis using the Kim grading system, and endplate changes using the Modic classification. Statistical analysis was performed using SPSS, with p<0.05 considered significant. **Results**: The mean age was 45.5±16.4 years, with male predominance (58%). Neck pain was present in all patients, while radiculopathy and myelopathy occurred in 73% and 24%, respectively. Multilevel degeneration was common, with two- and three-level involvement observed in 51% of patients. The C5–C6 level was most frequently affected (96%), followed by C4–C5 (84%) and C6–C7 (82%). Grade I disc degeneration predominated (53%), although Grade II degeneration was significantly associated with older age and male sex (p<0.05). Modic Type II changes were present in 62% of patients. Anterior osteophytes, posterior disc protrusion, disc space narrowing, and foraminal stenosis were observed in 91%, 71%, 67%, and 75% of patients, respectively. **Conclusion**: Cervical degenerative disc disease predominantly affects the lower cervical spine, particularly C5–C6, and increases with age. MRI provides reliable characterization and grading of degenerative changes, making it an indispensable tool for diagnosis, severity assessment, and clinical management of cervical spondylosis.*

Keywords: Cervical Spine, MRI, Degenerative changes, Foraminal Stenosis, Modic Changes

1. Introduction

Cervical spine degeneration involves age-related biochemical, structural, and mechanical changes to intervertebral discs, facet joints, vertebral endplates, and ligamentous structures. These changes may cause neck pain, radiculopathy, or cervical myelopathy when neural structures are affected, but many are asymptomatic. Instead of "wear and tear," intervertebral disc degeneration is now recognized as an abnormal, cell-mediated response to gradual structural failure caused by ageing, mechanical strain, and genetic predisposition".[1]

CT is useful for identifying bony abnormalities and osteophytes, but MRI is best for soft-tissue pathology and neural element damage in cervical spondylosis.[2] Cervical spine degeneration is best assessed with magnetic resonance imaging (MRI) due to its improved soft-tissue contrast, ability to directly visualize disc hydration, and ability to portray neural compression without ionising radiation.[2] MRI also demonstrates annular integrity, disc morphology, ligamentous hypertrophy, foraminal narrowing, and spinal cord signal abnormalities with high accuracy.

Research repeatedly reveals that degenerative cervical alterations grow with age. Many asymptomatic people have radiological abnormalities, and MRI and radiograph investigations show a gradual rise in disc degeneration, narrowing, and osteophyte production from middle age. [3,4] Methodical imaging evaluation and clinical assessment are needed due to the imprecise link between symptoms and imaging abnormalities. Although numerous studies show that lower cervical levels-particularly C5–6 and C6–7-are more affected, this pattern varies by population, occupational characteristics, posture, and spinal biomechanics. [2,4]

Correct cervical degenerative disease MRI assessment impacts clinical care. Deterioration distribution and severity predict neurological damage, advise conservative treatment, and recommend surgery. Surgeons use MRI to grade radiculopathy and myelopathy for decompression or fusion.[3] For populations exposed to chronic cervical stress or inadequate ergonomics, level-specific deterioration patterns can provide biomechanical insights and preventive methods.

Even with these advances, imaging cervical degenerative disease is still not perfect. Different colleges have different ideas about what degenerative features are, and people grade things in a lot of different ways. There are also no standardized ways to get MRI scans, which makes it impossible for research to be consistent.[5]

In this context, the current work sought to assess and classify degenerative alterations of the cervical spine utilising MRI, and to examine their distribution across cervical levels in a symptomatic patient sample.

2. Materials and Methods

The cross-sectional, observational study was conducted in the Department of Radio-Diagnosis at Index Medical College Hospital and Research Centre, Indore, Madhya Pradesh, over a period of 18 months. A total of 100 patients fulfilling the inclusion and exclusion criteria were selected for the study. The study was conducted after receiving Ethical clearance from the Institutional Ethics Committee and in accordance with the Declaration of Helsinki.

Inclusion Criteria

Patients of all age groups, belonging to both the genders, presenting with neck pain, neck stiffness, back pain and muscle weakness, ready to provide written informed consent.

Exclusion Criteria

Patients with cervical spine fractures detected prior to or during imaging, with contraindications to MRI (e.g., ferromagnetic implants), intramedullary spinal cord lesions such as tumors or demyelinating disorders, previously diagnosed spondylolisthesis, post-operative patients.

3. Procedure

A detailed clinical history was obtained from each patient, and relevant clinical findings were recorded in a structured proforma prepared for the study. Demographic details, clinical complaints, and neurological symptoms were noted.

All participants underwent magnetic resonance imaging (MRI) of the cervical spine using a 1.5-T GE Signa Explorer MRI scanner equipped with a phased-array spine coil. Patients were positioned supine, and standardized sagittal T1-weighted, sagittal T2-weighted fast spin-echo, and axial T2-weighted sequences were obtained. Imaging covered the region from the cerebellar tonsils to the D1 vertebral level, with axial sections acquired from C2–3 through C6–7.

MRI images were systematically evaluated at each cervical intervertebral disc level from C2–3 to C7–D1. The assessed degenerative parameters included disc degeneration, posterior and anterior disc protrusion, disc space narrowing, foraminal stenosis, spinal canal stenosis, and vertebral endplate changes.

Disc degeneration was graded according to the Suzuki classification. Neural foraminal stenosis was assessed on axial T2-weighted images using the Kim grading system and classified as normal, non-severe, or severe according to foraminal width relative to the extraforaminal nerve root. Vertebral endplate changes were evaluated using the Modic classification and categorized as Type I, II, or III.

All MRI findings were recorded in a structured proforma and entered into a master database for analysis. Data were evaluated on both a patient-wise and level-wise basis. Statistical analysis was performed using IBM SPSS Statistics. Categorical variables were summarized as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation. Fisher's exact test, Spearman's rank correlation coefficient, Mann–Whitney U test, and Kruskal–Wallis test were applied as appropriate. A p-value <0.05 was considered statistically significant.

4. Result

Table 1: Age and Sex Distribution of Study Subjects

Age Group (years)	Total, n (%)	Male, n (%)	Female, n (%)
<20 years	8 (8.0%)	4 (6.9%)	4 (9.5%)
20–29 years	5 (5.0%)	5 (8.6%)	0 (0.0%)
30–39 years	31 (31.0%)	13 (22.4%)	18 (42.9%)
40–49 years	12 (12.0%)	8 (13.8%)	4 (9.5%)
50–59 years	24 (24.0%)	12 (20.7%)	12 (28.6%)
60–69 years	8 (8.0%)	8 (13.8%)	0 (0.0%)
≥70 years	12 (12.0%)	8 (13.8%)	4 (9.5%)
Total	100 (100%)	58 (100%)	42 (100%)

Parameter	Overall (N=100)	Male (n=58)	Female (n=42)
Mean ± SD (years)	45.5 ± 16.4	44.7 ± 16.5	46.6 ± 16.4
Median (years)	45	45	44.5
IQR (years)	33–55	33–55	32–57
Range (years)	17–74	19–73	17–74

Mann-Whitney U = 1458.0, p = 0.0938 (NS) - No significant age difference between sexes.

A total of 100 patients were evaluated, comprising 58 males (58.0%) and 42 females (42.0%). The largest proportion of participants belonged to the 30–39 year's age group, accounting for 31.0% of the total study population. Within this group, females constituted a higher proportion (42.9%) compared to males (22.4%). The second most common age group was 50–59 years, representing 24.0% of the participants, with equal representation of males and females (20.7% and 28.6%, respectively).

The overall mean age of the study subjects was 45.5 ± 16.4 years. The mean age among males was 44.7 ± 16.5 years, while among females it was slightly higher at 46.6 ± 16.4 years. The median age was 45 years for the overall population and males, and 44.5 years for females. The interquartile range (IQR) for the entire study population was 33–55 years, with similar distributions observed in both sexes. The age of the participants ranged from 17 to 74 years overall, with ranges of 19–73 years for males and 17–74 years for females.

Statistical analysis using the Mann–Whitney U test showed no significant difference in age distribution between males and females (U = 1458.0, p = 0.0938).

Table 2: Clinical Profile - Presenting Symptoms

Symptom / Combination	N	%	Male n (%)	Female n (%)	p-value
Neck Pain (NP)	100	100%	58 (100.0%)	42 (100.0%)	-
Radiculopathy	73	73%	49 (84.5%)	24 (57.1%)	0.0031*
Myelopathy	24	24%	20 (34.5%)	4 (9.5%)	0.0043*
Neck pain only	27	27%	21 (36.2%)	6 (14.3%)	-
Neck pain + Radiculopathy only	49	49%	21 (36.2%)	28 (66.7%)	-
All 3 Symptoms (Neck pain +Radiculopathy +Myelopathy)	24	24%	20 (34.5%)	4 (9.5%)	-

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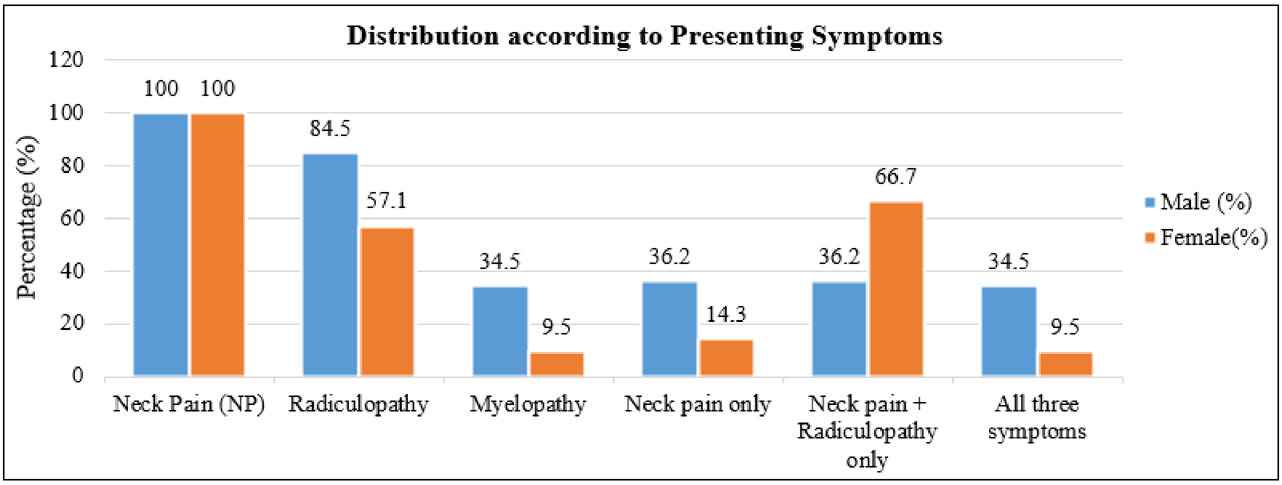
Radiculopathy: $\chi^2 = 7.90$, $p = 0.005$ - Males significantly more affected (84.5% vs 57.1%)
Myelopathy: $\chi^2 = 7.01$, $p = 0.008$ - Males significantly more affected (34.5% vs 9.5%)

Neck pain was present in all patients and constituted the universal presenting symptom. Radiculopathy was observed in 73% of patients and was significantly more common in males than females (84.5% vs. 57.1%, p = 0.005). Myelopathy was present in 24% of patients and also showed a significantly higher prevalence among males (34.5% vs. 9.5%, p = 0.008). Neck pain with radiculopathy was the most frequent symptom combination (49%), while 27% of patients presented with neck pain alone. The combination of neck pain, radiculopathy, and myelopathy was observed in 24% of cases, predominantly among males. These findings indicate that neurological manifestations of cervical degenerative disease, particularly radiculopathy and myelopathy, are significantly more frequent in male patients.



Graph 1: Bar diagram showing distribution according to presenting symptoms

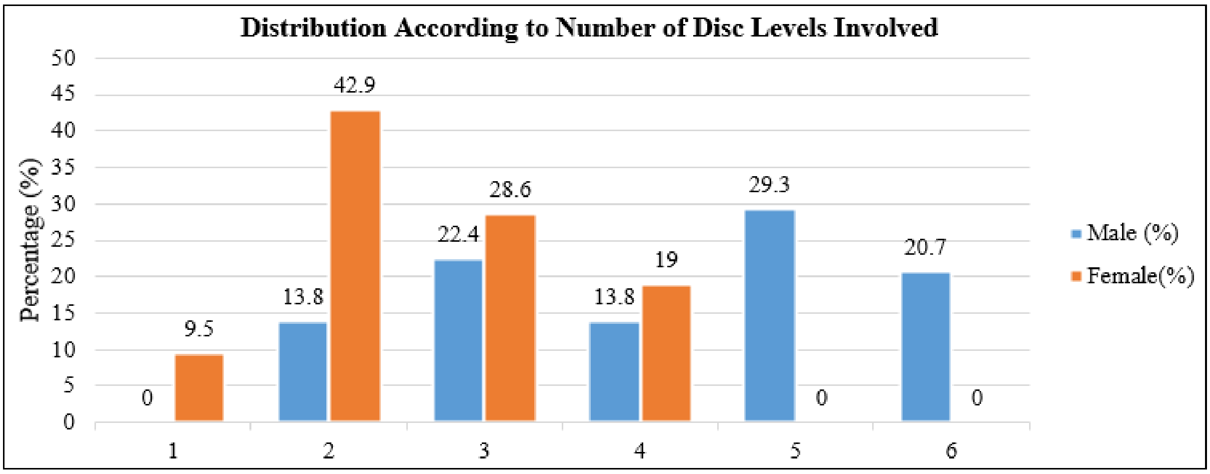
Table 3: Number of Disc Levels Involved per Patient

No. of Levels	Total n	% Patients	Male n (%)	Female n (%)
1	4	4%	0 (0.0%)	4 (9.5%)
2	26	26%	8 (13.8%)	18 (42.9%)
3	25	25%	13 (22.4%)	12 (28.6%)
4	16	16%	8 (13.8%)	8 (19.0%)
5	17	17%	17 (29.3%)	0 (0.0%)
6	12	12%	12 (20.7%)	0 (0.0%)
Total	100	100%	58	42

Spearman's $\rho = 0.568$, $p < 0.0001$ - Age strongly predicts number of levels involved

Fisher's Exact (Sex vs ≥3 Levels): $p < 0.0001$ - Males 50/58 (86.2%) vs Females 20/42 (47.6%)

Multilevel cervical disc involvement was common in the study population. Two-level (26%) and three-level (25%) involvement were the most frequent patterns, whereas single-level disease was uncommon (4%) and observed only in females. Extensive degeneration involving five or six disc levels was seen exclusively in males. Among females, two-level involvement predominated, while males more frequently demonstrated involvement of three or more levels. Overall, the findings indicate a greater burden of multilevel cervical degenerative disease among male patients.



Graph 2: Bar diagram showing distribution according to number of disc levels involved

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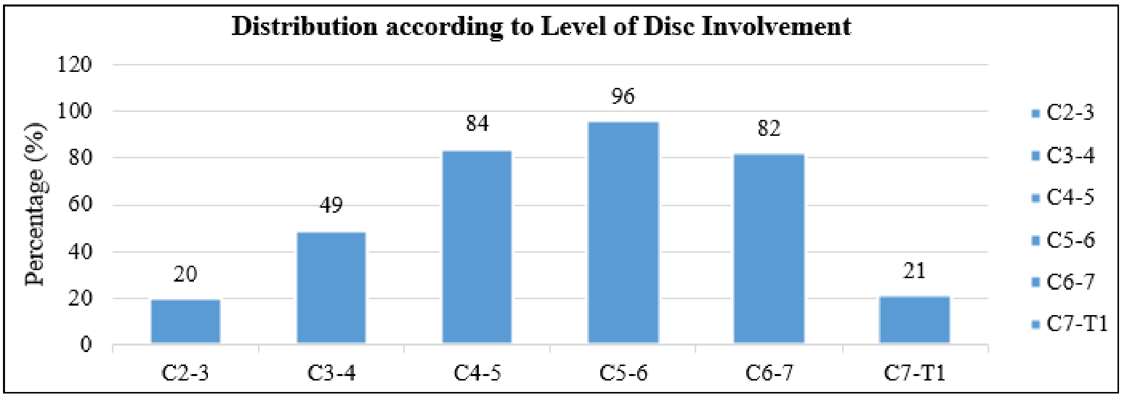
Table 4: Level-wise Distribution of Disc Involvement

Disc Level	Patients Affected	% of Patients	Rank
C2-3	20	20.0%	6
C3-4	49	49.0%	4
C4-5	84	84.0%	2
C5-6	96	96.0%	1
C6-7	82	82.0%	3
C7-T1	21	21.0%	5

Cervical disc degeneration predominantly involved the lower cervical spine. The C5–C6 level was the most frequently affected segment (96%), followed by C4–C5 (84%) and C6–C7 (82%). Moderate involvement was observed at C3–C4 (49%), whereas C2–C3 (20%) and C7–T1 (21%) were least affected. These findings demonstrate a clear predilection for degenerative changes at the mid-to-lower cervical levels, particularly C5–C6, likely reflecting greater biomechanical stress and mobility at these segments.



Graph 3: Bar diagram showing distribution according to level of disc involvement

Table 5: Disc Degeneration Grade Distribution per Level

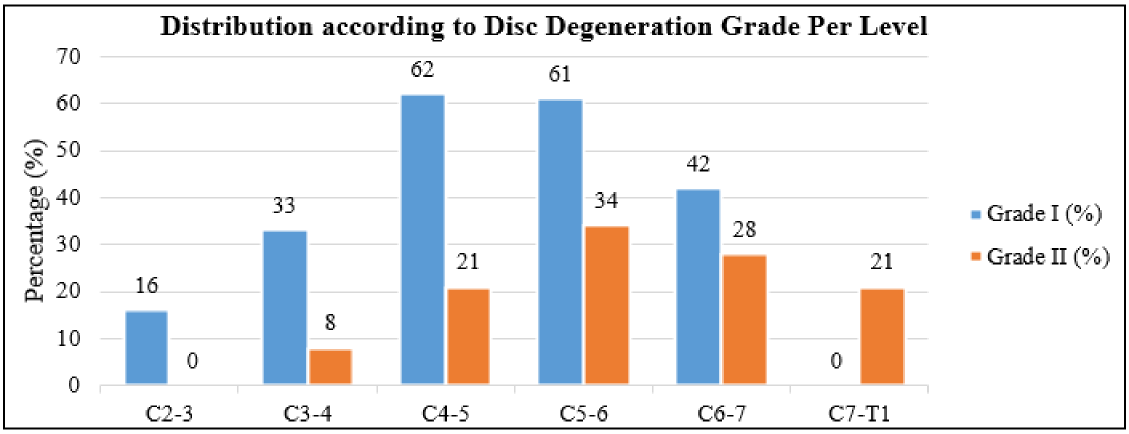
Disc Level	Grade I (Mild) n (%)	Grade II (Moderate) n (%)	Total Level-Entries	% Patients Affected	Predominant Grade
C2-3	16 (16%)	0	16	20%	Grade I
C3-4	33 (33%)	8 (8%)	41	49%	Grade I
C4-5	62 (62%)	21 (21%)	83	84%	Grade I
C5-6	61 (61%)	34 (34%)	95	96%	Grade I
C6-7	42 (42%)	28 (28%)	70	82%	Grade I
C7-T1	0	21 (21%)	21	21%	Grade II

Grade 0 = 0 patients | Grade I (max) = 53 patients (53%) | Grade II (max) = 47 patients (47%) | Total level-entries: G1=214, G2=112

Kruskal-Wallis (Age vs Max Grade): $H = 6.500$, $p = 0.0108$ - Grade II patients significantly older

Fisher's Exact (Sex vs Grade II): $p = 0.0258$ - Males 33/58 (56.9%) vs Females 14/42 (33.3%)

Grade I degeneration was the predominant MRI finding across most cervical levels, with the highest involvement at C5–C6, followed by C4–C5 and C6–C7. Grade II degeneration was also most frequently observed at these levels, while C2–C3 demonstrated only mild (Grade I) changes. At C7–T1, all degenerative changes were classified as Grade II. Overall, 53% of patients exhibited Grade I degeneration and 47% showed Grade II degeneration. Higher degeneration grades were significantly associated with increasing age ($p = 0.0108$) and were more common in males than females (56.9% vs. 33.3%, $p = 0.0258$), indicating that advanced cervical disc degeneration is related to older age and male sex.



Graph 4: Bar diagram showing distribution according to disc degeneration grade per level

Table 6: Modic Changes - Type and Level Distribution

a) Overview

Category	N	% Total	Male n	Female n
Any Modic Change	62	62%	36	26
Modic Type I	0	0%	0	0
Modic Type II (Fatty marrow)	62	62%	36	26
Modic Type III	0	0%	0	0
No Modic Change	38	38%	22	16

b) Modic Type II - Vertebral Level Distribution

Vertebral Level	n	% Total (N=100)	% of Modic+ (n=62)
C2	38	38.0%	61.3%
C3	50	50.0%	80.6%
C4	38	38.0%	61.3%
C5	36	36.0%	58.1%
C6	24	24.0%	38.7%
C7	17	17.0%	27.4%

Mann-Whitney U (Age: Modic+ vs Modic-): p = 0.0056 - Modic+ patients significantly older

Fisher's Exact (Sex vs Modic Type II): p = 1.0000 (NS) - 36 males vs 26 females; not significant

As shown in Table 6a, Modic changes were observed in 62% of patients, while 38% showed no vertebral endplate changes on MRI. All identified changes were classified as Modic Type II, with no cases of Type I or Type III detected. The presence of Modic changes was significantly associated with increasing age (p = 0.0056), whereas no significant sex-related difference was observed (p = 1.000).

In Table 6b, Modic Type II changes most commonly involved the C3 vertebral level (50%), followed by C2 and C4 (38% each). Lower frequencies were observed at C5 (36%), C6 (24%), and C7 (17%). These findings indicate that vertebral endplate changes predominantly affect the upper to mid-cervical vertebrae in patients with cervical degenerative disease.

Statistical analysis revealed that patients with Modic changes were significantly older compared to those without such changes (Mann–Whitney U test, p = 0.0056). However, no statistically significant association was observed between sex and the presence of Modic Type II changes (Fisher's exact test, p = 1.0000). These findings suggest that vertebral endplate changes, particularly Modic Type II alterations, are relatively common in cervical spine degeneration and tend to occur more frequently with increasing age.

Table 7: Osteophytes - Anterior and Posterior Distribution

a) Overview

Type	N	% Patients	Male n (%)	Female n (%)
Anterior Osteophytes	91	91.0%	53 (91.4%)	38 (90.5%)
Posterior Osteophytes	46	46.0%	32 (55.2%)	14 (33.3%)
Both Anterior & Posterior	42	42.0%	-	-
No Osteophytes	5	5.0%	-	-

b) Level-wise Distribution

Vertebral Level	Anterior, n (%)	Posterior, n (%)
C2	20 (20.0%)	4 (4.0%)
C3	45 (45.0%)	12 (12.0%)
C4	87 (87.0%)	33 (33.0%)
C5	91 (91.0%)	30 (30.0%)
C6	91 (91.0%)	38 (38.0%)
C7	82 (82.0%)	22 (22.0%)

Fisher's Exact (Sex vs Anterior Osteophytes): p = 1.0000 (NS)

Fisher's Exact (Sex vs Posterior Osteophytes): p = 0.0420 - Males 32/58 (55.2%) vs Females 14/42 (33.3%)

As presented in Table 7a, anterior osteophytes were the most common finding, observed in 91% of patients. The prevalence was similar in both sexes, occurring in 91.4% of males and 90.5% of females. Posterior osteophytes were identified in 46% of the study population, with a higher occurrence in males (55.2%) compared to females (33.3%). Additionally, both anterior and posterior osteophytes were present in 42% of patients, while only 5% of patients showed no osteophyte formation.

Table 7b illustrates the level-wise distribution of osteophytes. Anterior osteophytes were most frequently observed at the C5 and C6 vertebral levels, each affecting 91% of patients. This was followed by the C4 level (87%) and C7 level (82%). Lower frequencies were noted at C3 (45%) and C2 (20%). Posterior osteophytes were most common at the C6 level (38%), followed by C4 (33%), C5 (30%), and C7 (22%), while relatively fewer cases were seen at C3 (12%) and C2 (4%).

Statistical analysis revealed no significant association between sex and the presence of anterior osteophytes (Fisher's exact test, p = 1.0000). However, posterior osteophytes were significantly more common in males than females (55.2% vs 33.3%; Fisher's exact test, p = 0.0420). These findings indicate that osteophyte formation, particularly anterior osteophytes, is highly prevalent in cervical spine degeneration, with posterior osteophytes showing a greater predilection for male patients.

Table 8: Distribution of Major Degenerative MRI Findings Across Cervical Disc Levels

Disc Level	Posterior Disc Protrusion n (%)	Disc Space Narrowing n (%)	Foraminal Stenosis n (%)
C2–C3	8 (8.0%)	4 (4.0%)	4 (4.0%)
C3–C4	16 (16.0%)	12 (12.0%)	21 (21.0%)
C4–C5	45 (45.0%)	41 (41.0%)	40 (40.0%)
C5–C6	43 (43.0%)	59 (59.0%)	50 (50.0%)
C6–C7	36 (36.0%)	32 (32.0%)	40 (40.0%)
C7–T1	4 (4.0%)	4 (4.0%)	17 (17.0%)
Total Patients Affected	71 (71.0%)	67 (67.0%)	75 (75.0%)

Statistical Analysis

Finding	Male (%)	Female (%)	p-value
Posterior Disc Protrusion	70.7	71.4	1.000 (NS)
Disc Space Narrowing	77.6	52.4	0.0102*
Foraminal Stenosis	84.5	61.9	0.0182*

*Statistically significant (p < 0.05); NS = Not significant.

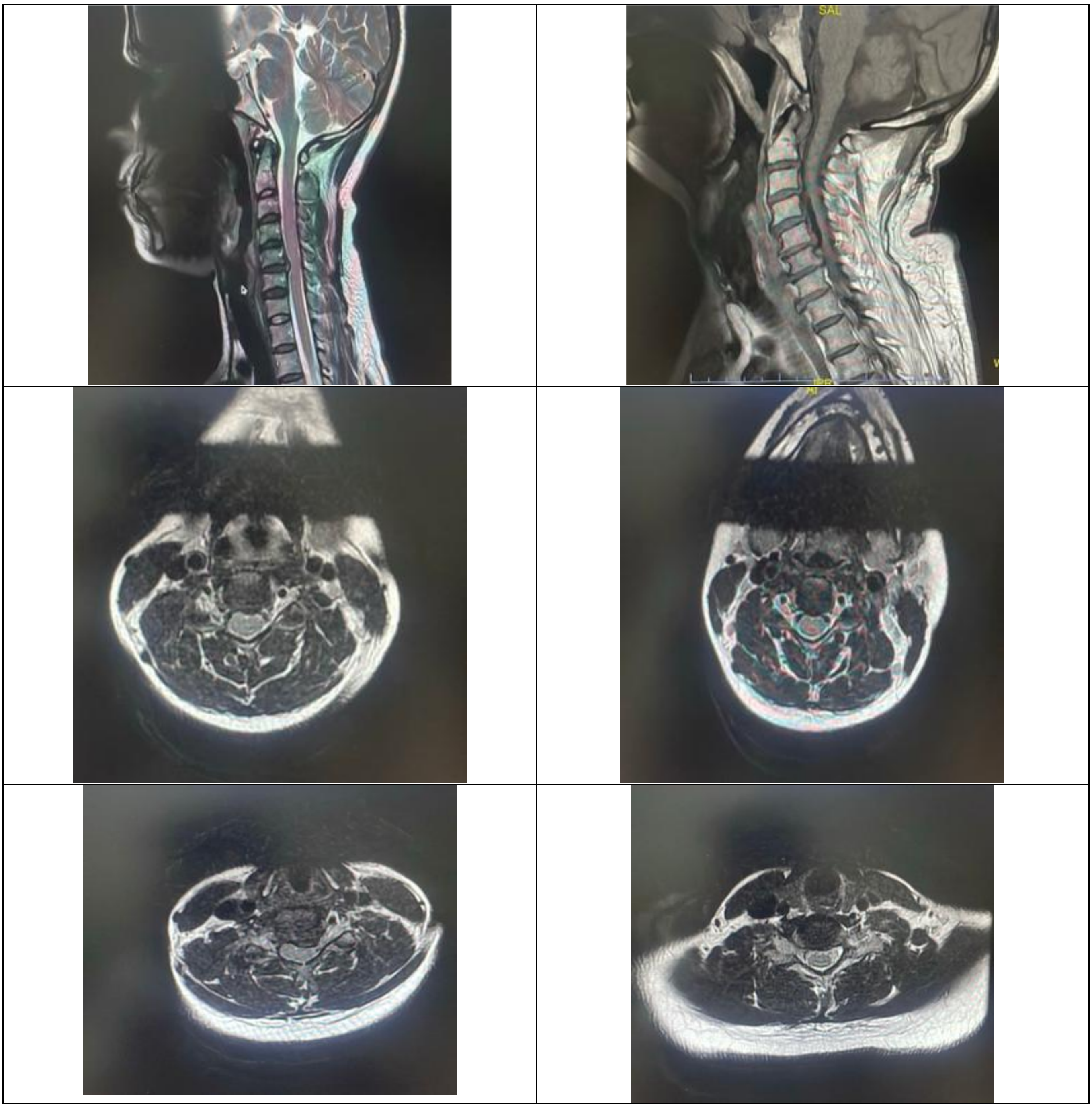
Posterior disc protrusion, disc space narrowing, and foraminal stenosis were observed in 71%, 67%, and 75% of patients, respectively. All three abnormalities predominantly involved the mid-to-lower cervical spine, particularly the C4–C5, C5–C6, and C6–C7 levels. C5–C6 was the most commonly affected level for disc space narrowing and foraminal stenosis, whereas posterior disc protrusion was most frequent at C4–C5. Disc space narrowing and foraminal stenosis were significantly more common in males ($p = 0.0102$ and $p = 0.0182$, respectively), while posterior disc protrusion showed no significant sex-related difference. These findings highlight the predominance of degenerative changes at the lower cervical segments and their greater severity among male patients.

Case-1

Male, 65 years old
Clinical details: Neck pain radiates to bilateral upper limb with tingling and numbness

Case-2

Female, 33 year's old
Clinical details: Neck pain radiates to bilateral upper limb with tingling and numbness



5. Discussion

The study used MRI to evaluate, define, and grade cervical spine degenerative alterations and analyse their distribution patterns. The results are reviewed below in light of other investigations.

The present study demonstrated a male predominance (58%) with a mean age of 45.5 ± 16.4 years, indicating that cervical degenerative disc disease primarily affects middle-aged adults. Similar findings were reported by Deepu and Venkateshwaran [6] and Ganie et al. [7], who observed a higher prevalence among males with comparable mean ages. Tao et al. [8] further demonstrated that both the prevalence and severity of cervical degeneration increase with advancing age. Although males predominated in the present cohort, no significant age difference was observed between sexes, suggesting that factors other than age may contribute to the higher disease burden in males.

Neck pain was the universal presenting symptom, while radiculopathy and myelopathy were observed in 73% and 24% of patients, respectively. Both neurological manifestations were significantly more common among males. Daimon et al. [9] reported that foraminal stenosis is strongly associated with upper-limb pain and radiculopathy, supporting the high prevalence of radicular symptoms observed in this study. Similarly, Zhang et al. [10] emphasized the importance of MRI in detecting spinal cord involvement in cervical spondylotic myelopathy, highlighting the clinical relevance of neurological symptoms identified in the present cohort.

Multilevel degeneration was a prominent feature, with two- and three-level involvement being the most common patterns and a significant positive correlation observed between age and the number of affected levels. Similar age-related increases in multilevel degeneration were reported by Suzuki et al. [11]. The significantly higher frequency of multilevel disease among males suggests a greater susceptibility to progressive cervical degeneration, independent of age.

Degenerative involvement predominantly affected the lower cervical spine, with C5–C6 being the most frequently involved level, followed by C4–C5 and C6–C7. These findings are consistent with those of Suzuki et al. [11], Ganie et al. [7], and Raj and Muthu [12], all of whom identified C5–C6 as the principal site of degeneration. The predominance of these levels is likely related to increased biomechanical stress and segmental mobility.

Grade I degeneration predominated overall, although nearly half of the patients demonstrated Grade II changes. Degeneration severity increased significantly with age and was more common among males. Studies by Miyazaki et al. [13], Jacobs et al. [14], Fu et al. [15], and Moll et al. [16] have also confirmed the reliability and clinical utility of MRI-based grading systems in assessing cervical disc degeneration.

Modic changes were present in 62% of patients, with all cases classified as Type II. The absence of Type I and Type III changes suggests a predominance of chronic fatty endplate degeneration. Modic changes were significantly associated with increasing age but showed no sex predilection. Similar age-dependent progression of degenerative changes has been described by Daimon et al. [9]. The predominance of Type II changes indicates longstanding degenerative pathology rather than active inflammatory endplate disease.

Osteophyte formation was highly prevalent, with anterior osteophytes observed in 91% and posterior osteophytes in 46% of patients. Anterior osteophytes showed no sex difference, whereas posterior osteophytes were significantly more common among males. Tao et al. [8] similarly reported increasing osteophyte formation with age, particularly at lower cervical levels. The higher prevalence of posterior osteophytes in males may contribute to the increased rates of foraminal stenosis, radiculopathy, and myelopathy observed in this study.

Posterior disc protrusion, disc space narrowing, and foraminal stenosis predominantly involved the C4–C5, C5–C6, and C6–C7 levels, highlighting the susceptibility of the lower cervical spine to degenerative changes. Posterior disc protrusion was observed in 71% of patients and showed no sex difference, consistent with findings by Deepu and Venkateshwaran [6] and Raj and Muthu [12]. Disc space narrowing was present in 67% of patients and was significantly more common among males, supporting observations by Tao et al. [8] and Raj and Muthu [12]. Foraminal stenosis was the most frequent neural compromise finding (75%) and demonstrated a significant male predominance. Daimon et al. [9] identified foraminal stenosis as the degenerative change most strongly associated with radiculopathy, while Ganie et al. [7] similarly reported predominant involvement of the lower cervical spine. Collectively, these findings indicate that degenerative MRI abnormalities are concentrated at mechanically stressed lower cervical levels and are associated with greater neurological compromise in males.

The present study has several limitations. Its cross-sectional design precludes assessment of temporal progression and causal relationships between MRI findings and clinical symptoms. Being a single-center study, the findings may have limited generalizability. The simplified two-grade degeneration classification may not capture the full spectrum of disease severity compared with more detailed grading systems proposed by Suzuki et al. [11] and Miyazaki et al. [13]. The absence of an asymptomatic control group limits differentiation between age-related and symptomatic degenerative changes. Inter-observer and intra-observer reliability of MRI grading were not evaluated. Additionally, the sample size was insufficient for multivariate logistic regression analysis to identify independent predictors of severe degeneration.

6. Conclusion

Overall, the findings of this study indicate that cervical degenerative disc disease is an age-related condition that predominantly affects the mid-to-lower cervical spine and shows greater severity in male patients. MRI with standardized grading systems provides accurate anatomical characterization of degenerative changes, facilitates assessment of disease severity, and supports clinical decision-making. The results highlight the reproducibility and clinical utility of MRI as a comprehensive imaging modality for evaluating cervical spondylosis in symptomatic patients.

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