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Original Research Paper

Radiology

MRI EVALUATION OF CERVICAL SPINE DEGENERATIVE CHANGES IN YOUNG ADULT

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ABSTRACT **Introduction:** The degeneration of the cervical spine that occurs during the normal course of aging may progress into compression of the spinal cord, or cervical spondylotic myelopathy (CSM), which can cause neurologic dysfunction. Age related degenerative changes are more common among them, but some metabolic disorder like DM, tobacco consumption, cigarette smoking, sedentary life style, bad neck posture aggravates degenerative changes. **Materials and Methods:** In two years observational cross sectional study , around 53 ,young adult between age group 15-40 years were subjected to MRI cervical spine. Cervical Spine is assessed for cervical lordosis by measuring kobb's angle, Disc bulge, spinal canal, neural foramen and associated vertebral anomaly also noted. **Result :** Cross sectional observational study we found that degenerative changes in symptomatic patient are high in age group >30 years, however point prevalence in symptomatic patient is found to be 73%. Neck pain was associated with loss of cervical lordosis either straightening of cervical spine or kyphotic curvature. The degree of loss of cervical lordosis is directly proportional to disc bulge and mild cervical canal stenosis. **Conclusion:** MRI is a very useful technique for evaluation of degenerative changes in cervical spine. Hypertension, tobacco use, DM, smoking obesity and sickle cell disease were associated risk factors. Intervertebral disc levels C5-C6 is the most common level that affect in degenerative changes in cervical spine.

KEYWORDS : cervical spine; degenerative changes; disc bulge; lordosis

INTRODUCTION

Neck pain is a common health problem and increasingly relevant in health-related quality of life (HRQOL) not only in the industrialized countries. 70% of adults suffer from it at some time in their lives while 10%–40% of adults are bothered by neck pain each year. Chronic neck pain that had persisted more than 6 months in the previous year is reported by 10%–15% of adults. In terms of prevalence, in the population over 40 years of age, 20% experience neck pain out of which 5% of disabling intensity.

Cervical spondylitis is a chronic degenerative process of the cervical spine that affects the vertebral bodies and intervertebral discs of the neck, and may progress into disc herniation, bony spur formation [1].

The lifetime incidence of neck-related pain in the population has been reported to be as high as 67% of the population experiencing it. The incidence of cervical radiculopathy is much lower. Point prevalence has been placed at 3.5/1,000 while the annual incidence has been reported at 83/100,000 population Cervical spondylosis adversely affects life quality for its heavy disease burden. The prevalence of cervical spondylosis was 13.76%, although it differed significantly among the urban, suburban, and rural populations (13.07%, 15.97%, and 12.25%, respectively). Moreover, it was higher in females than in males (16.51% vs. 10.49%). [2]

The degeneration of the cervical spine that occurs during the normal course of aging may progress into compression of the spinal cord, or cervical spondylotic myelopathy (CSM), which can cause neurologic dysfunction. Cervical spondylosis can be identified in the majority of people older than 50 years. Many people with cervical spondylosis or CSM are asymptomatic. [3]

Need for this study is to early diagnosis of disc bulge and changes of cervical spondylotic myelopathy (CSM) because patients with CSM are at higher risk of spinal cord injury (SCI) following minor injury.

Aims and objectives

- To study the MRI findings in cervical spine degeneration in young adult age of 15- 40 years.
- To study risk factor for degenerative cervical spine disease below age of 40 years in study population.

Subjects and Methods:

Source of data:

Fifty three patients referred From Department Of Orthopedics and Neurosurgery with specified inclusion criteria were taken for MRI cervical spine and evaluated with informed consent between the period Sept 2017 to Nov 2019 using Sense and neurovascular Coil.

Inclusion criteria: In this study, we include patients referred From Department Of Orthopedics and Neurosurgery with any of given clinical symptom.

1. Patients with cervical radiculopathy below age 40years
2. Patients with neck pain
3. Patients with headache
4. Patients with giddiness

Exclusion criteria

1. Patients with cardiac pacemakers, prosthetic limbs or heart valves, metallic implants, or metallic foreign body.
2. Patient > 40 years of age.
3. Cervical spine trauma
4. Claustrophobic

All patients underwent a routine plain MRI of the cervical spine. MRI of the cervical spine has been performed on 1.5-T Philips Achieva. The MRI protocol included T1 sagittal (TR – 430 ms, TE – 60 ms); T2 sagittal and axial (TR – 4200 ms, TE – 120 ms); and STIR coronal and sagittal (TR – 4000 ms, TE – 70 ms). Slice thickness was 3 mm. Field of view (FOV) was 32–37 cm. The frequency encoding direction was in cephalo-caudal direction.

Approval: Approval for conduction of study was taken from Institutional Ethics Committee.

Imaging and clinical assessment :

All patients underwent cervical magnetic resonance imaging (MRI) detection .MRI cervical spine is taken in neutral resting position. The following lines were drawn on the lateral radiographs of cervical vertebras according to Borden's method .

A— between posterior superior marginal of C2 odontoid process and posterior inferior edge of C7 vertebra, B—along the trailing edge of the cervical vertebrae, C—the longest distance between line A and B as the cervical curvature value, and D—apical vertebra. To determine the disc space heights in MRI, the following lines were drawn: E—between the inferior and superior end plate, F— the sagittal diameter of spinal canal, and G—the sagittal diameter of spinal dura mater. The degree of cervical spinal cord compression was calculated in terms of the G/F ratio. Finally, the line H was drawn on the transverse MRI section to determine the degree of disc herniation. Based on the assessment of MRIs, the apical vertebra, segment of intervertebral disc protrusion, the sagittal diameter of spinal dura mater, the sagittal diameter of spinal canal, height of disc space, cervical curvature.

Statistical analysis

Statistical analysis was performed with the SPSS software package IBM version 23. Statistics were estimated for demographic data as means and standard deviations [SD]. Data entry was done by the investigator using Microsoft Excel 2019 version. After applying Fisher's Exact test we found a significant correlation between degenerative changes and age as P- value less than 0.05.

Results

A total number of 53 patients with proper inclusion and exclusion criteria are subjected to MR scanning with brief clinical history, risk factors and life style habits were noted. Correlation with the general examination, local examination findings, and relevant investigation (radiographs) was done. The study was carried out observational cross sectional manner over the period of 2 years. Following observations were made from the study. In this study of 53 patients most common age group was above 35-40 years. Among them 17 (56 %) were between 36-40 years. Mean age was 30.96 ± 7.13 years [Table 1] . In this study 33.96 % of the population was females and 66.03% were males

Male to female ratio is approximately 1:2.

Table No 1 Age distribution of patients.

Age in years	No. of Cases	Percentage
15-20	6	11.32075%
21-25	9	16.98113%
26-30	8	15.09434%
31-35	13	24.5283%
36-40	17	32.07547%
Total	53	100%
Mean Age ±SD (Range)	30.96± 7.13 (15-40)	

Comorbidities and risk factors:

Out of total 53 patients 2 patients were hypertensive, 2 were diabetic, 7 patients were smoker/tobacco chewer. 3 patients were of Sickle cell disease below age group of 20. 4 patients were of obesity, 6 patients have sedentary life style. The distribution of degenerative changes in cervical spine is described.

Frequency of disc bulge increases with age. The highest numbers of intervertebral disc bulge were found in age group 36-40 ie.39 discs followed by 31-35 years. After applying Fisher's exact test we found significant association between intervertebral disc bulges at intervertebral disc level with age. We found P-Value 0.006(<0.05) which is statistical significant. Highest number of disc bulge found at C5-C6 vertebral level so we evaluate the age wise distribution of disc bulge at this level and found that 12 patients out of 13 were having disc bulge in 31-35 age group followed by 12 patients out of 17 in 36-40 age group so prevalence of disc bulge were highest at C5-C6 intervertebral disc level in 31-35 years age group found to be 92%, 12 patients out of 53 were in 31-35 years and 36-40 years age group

Table no 2: Degenerative changes at various intervertebral disc level in cervical spine

Mri Finding		C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-T1
Modic changes	Type-I	0	1	3	3	1	0
	Type-II	0	3	6	16	5	3
	Type-III	0	0	0	0	0	0
Spinal canal stenosis	Mild	2	11	11	25	12	1
	Moderate	0	1	0	0	0	0
	Severe	0	0	1	1	0	0
Disc desiccation	1	4	3	6	5	1	
Neural foraminal compromise	1	10	9	12	1	1	
Disc bulge	3	16	18	32	18	2	

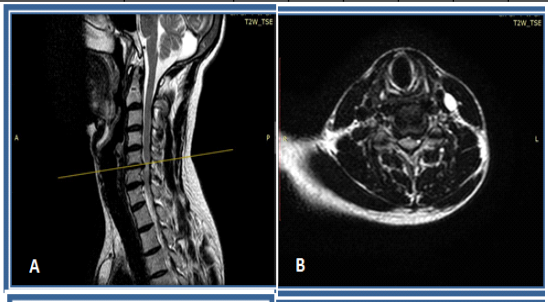

Fig 1: MRI cervical spine T2 sag(A) and T2 axial image shows posterior disc bulge indenting anterior subarachnoid spaces causing mild spinal canal stenosis with moderate compression of bilateral exiting Nerve roots.

Total 39 (73.58%) patient having neck pain, however we found total 31(58.49%) patients having loss of cervical lordosis. After applying Fisher's Exact Test, we found P-value-0.001 (ie. <0.05), It is suggestive of strong association between loss of cervical lordosis and neck pain. There are 31 out of 31 patients (100%) who had loss of cervical lordosis had neck pain.

There are total 24 vertebral bodies with osteophyte spur formation. These osteophytes spur causing secondary spinal canal stenosis .In our study we found 3 osteophytes spur at C3 vertebral level, followed by 6 patients C4 vertebral levels. Highest prevalence of osteophyte spur formation was found at C5 vertebral levels, ie.9 out of 24(37%).

Table No.3 Distribution of Disc bulge in the patients with age

AGE	Disc Bulge					
	C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-T1
15-20	0	1	0	1	1	0
21-25	0	3	3	2	2	0
26-30	0	0	0	5	3	0
31-35	1	5	5	12	5	0
36-40	2	7	10	12	6	2

Type II Modic changes are usually found in degenerative spine. Type I modic changes most commonly found in C5-C6 and C4-C5, C5-C6 vertebral end plate. However Type II modic changes were found at 33 vertebral endplates. Most common type II Modic changes were found at C5-C6 vertebral level followed by C4-C5 and C6-C7 vertebral endplates. After applying Fisher's Exact Test, we found P-value-0.001 (ie. <0.05) s/o strong association is present between Type II modic Changes at C5-C6 vertebral endplates in cervical spine degeneration in young adult.

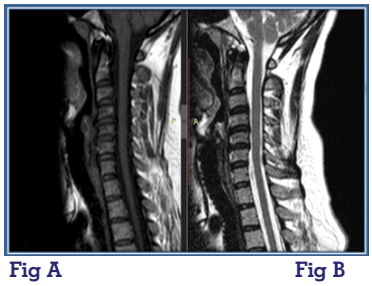

Fig A **Fig B**

Fig2 : MRI cervical spine T1 sag(A) and T2 Sag(B) images shows Type 1 modic changes more marked at C5-C6 endplates.

Disc bulge, ligamentum flavum hypertrophy, osteophyte spurs formation and posterior longitudinal ligament hypertrophy is causing spinal canal stenosis. The distribution of spinal canal stenosis with age is given as follow. There are total 29 cases of spinal canal stenosis were found out of 53 patients. There are total 11 patients were found between 31-35 years followed by 9 patients were in 36-40 years of age group. In our study we found total 39 (73.58%) patient having neck pain, however we found total 31(58.49%) patients having loss of cervical lordosis. After applying Fisher's Exact Test, we found p value-0.001 (ie. <0.05), it is suggestive of strong association between loss of cervical lordosis and neck pain. It shows that there is an association between loss of cervical lordosis and neck pain.

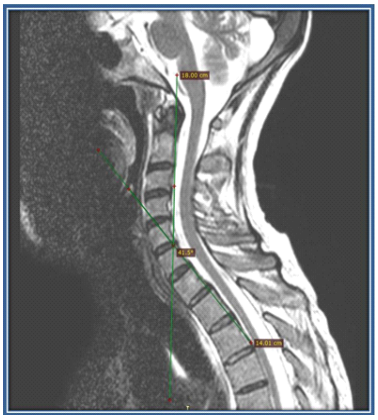

Fig3 : MRI cervical Spine T2 sag images shows exaggerated cervical lordosis which has association with neck pain.

In a sickle cell patients with neck pain , we found that straightening of cervical cord with marrow conversion which shows T2 hypo intensity in cervical vertebral bodies [fig 4].

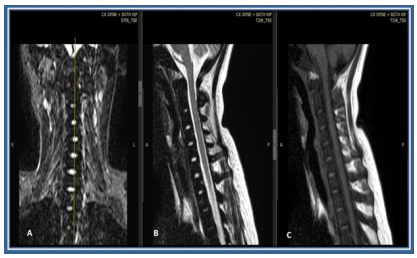

Fig 4: MRI cervical spine in Sickle cell disease shows STIR Cor (A) , T2 Sag (B), T1 Sag(C) shows straightening of cervical spine with diffuse T2 hypo intensity is seen in vertebral bodies with loss of cervical lordosis .

DISCUSSION:

We found that there are various factors that show association with cervical spine degeneration. Degenerative changes in cervical start appearing in early ages , as the age increases, degenerative changes also increases. Sedentary life style, Smoking and Sickle cell disease contributes to cervical spine degeneration in young adult. In this study of 53 patients, most common age group was 35-40 years. Among them 17 were between 36-40 years. Only 6cases were reported to be below 20 years and 13 cases were between 31-35 years. In the present study, the mean age of the patients included was 30.96± 7.13 years. This is in concordance with most clinical series of degenerative changes reveal that it occurs most commonly occur as the age increase. There is strong association between increase in age and cervical spine degeneration. As the age decreases, there are higher levels are susceptible for degeneration which is consistent with study done by DAI et al.] , in 1998.

Degenerative changes in cervical spine and found that the incidence of cervical radiculopathy is much lower. Point prevalence has been placed at 3.5/1,000 while the annual incidence has been reported at 83/100,000 population. The lifetime incidence of neck-related pain in the population has been reported to be as high as 67% with up to 54% of the population experiencing it within the last 6 months. In the present study we found that degenerative changes in symptomatic patient is high in age group >30 years, however point prevalence in symptomatic patient is found to be 73% which is consistent with study done In 2009 , by Todd et al., [4]. Walraevens et al.[6], In 2009 has shown in his study while assessing Qualitative and quantitative assessment of degeneration of cervical intervertebral discs and facet joints that there is weak spatial correlation between cervical intervertebral disc and facet joint degeneration has been observed. In our study we don't find any case of facetal arthropathy and came to conclusion that it has least association with the intervertebral disc degeneration.

Morishita et al., in 2009 studied the relationship between the cervical spinal canal diameter and the pathological changes in the cervical spine and found that average sagittal diameter of the cervical spinal canal (the average of the sagittal canal diameters at the pedicle level from C3 to C7.)For the 295 subjects, the average canal diameter was 13.73 ± 1.37 mm. In our study we found that average spinal canal diameter was 12mm. we also divide the spinal canal diameter into mild, moderate and severe grades depending on their canal diameter. We found that 11 patients out of 13 patients had spinal canal stenosis in age group 31-35 which shows that as the age increases spinal canal diameter decreases. We also found that these mild spinal canal compromises were seen at C5-C6 level.

Present study reveals 76.47 % 13 out of 17 patients in 36-40 age group and 85.71 % patient IN 31-35 age groups and found that the proportion of cervical spondylosis increases with aging in

the young adults however other risk factor likely to aggravates the degenerative process. Findings in our study are consistent with Study done by Wang et al. In 2014Teraguchi et al.,

We found the prevalence at C5/ 6 was 60 % (95% CI), followed by the prevalence at C6/7 of 32. % in men and 33.3% in women, and at C4/5 of 33.96%, however Wakayama Spine Study and investigate the prevalence and distribution of intervertebral disc degeneration (DD) over the entire spine using magnetic resonance imaging (MRI), and to examine the factors and symptoms potentially associated with DD. They found that the prevalence at C5/ 6 was 51.5% (95% CI: 46.1-56.3) in men and 46% (95% CI: 42.2-49.9) in women, followed by the prevalence at C6/7 of 43.5% in men and 33.3% in women, and at C4/5 of 38.6% in men and 35.8% in women.

In present study, neck pain was associated with 39 patients out of them 31 patients were associated with loss of cervical lordosis either straightening of cervical spine or kyphotic curvature. These finding shows that there is strong correlation between loss of cervical lordosis and neck pain. The degree of loss of cervical lordosis is directly proportional to disc bulge and mild cervical canal stenosis. So, findings in our study are consistent with Study done by Gao et al in 2019 [9].

In 2013, KIM et al., studied the Prevalence of Disc Degeneration in Asymptomatic Korean Subjects They found that the score of bulging slightly increased along with the age, but not proportional to the age. Bulging was almost not seen at the level of C2/3, but the most common levels were C5/6 and C4/5. Protrusion was almost not seen at the level of C2/3, but the most common levels were C5/6. Extrusion of disc was found in 30.7 (5.0%) of all 612 discs in 23.3 (22.9%) of the 102 subjects.

In our study we found only 3 patients in age group 30-35 and 36-40 years with disc bulge at level C2-C3. However highest prevalence of disc bulge was found at C5-C6 (60.37%), followed by C4-C5 (33.96%), and C6-C7 (32.07%) intervertebral disc level.

In our study we found 16 patients out of 53 (30.18 %) had type II modic changes at C5-C6 vertebral level, followed by C4-C5 vertebral level in 6 out of 53 (11.32%). these finding were consistent with the study done by Kang et al[11].

In our study we found that 2 patients were having DM out of them one is type1 and another is type 2. A female patient who is having type 1 DM is on regular insulin, however male patient is on oral hypo glycemic drugs. Both of them had disc bulge with mild spinal canal compromise with loss of et cervical lordosis and having clinical symptoms of neck pain. So our results are consistent with results of Tsai al done in In 2014[12]. Our study may be limited by several factors. A crude correlation between the grade of stenosis and neurologic deterioration suggestive of myelopathy has been shown. However, further investigation based on elaborate assessment of symptoms, such as the Japanese Orthopaedic Association score[13], is needed to elucidate the correlation between the grades and the severity of symptoms and the association of preoperative grades with outcome in patients undergoing surgical treatment. We focused on the simplicity of the grading system for its universal use.

Summary:

1. In this study of 53 patient's most common age group was 30-35 and 35-40 years. Among them 17 were between 36-40 years. Only 6 cases were reported to be below 20 years. The mean age of the patients included was 30.96 ± 7.13 years, Male to female ratio is approximately 1:2.
2. Co-morbidities includes, 4 out of 53 patients were obese, 3 patient of sickle cell disease, 2 hypertensive.
3. Total 10 out of 13 (76.92%) and 12 out of 17 (70.58%) neck pain patients were is age group of 30.-36 and 36-40 years respectively. This indicates that as the age increases the association with neck pain with age also increases.
4. There are total 31 out of 53 (58.49%) patient were having loss of cervical lordosis, 39 out of 53 patients having neck pain. This study comes to conclusion that neck pain having strong association with loss of cervical lordosis with P value is < 0.01 suggestive of strong association of neck pain with loss of cervical lordosis.
5. We found disc bulge in total 37 patients out of 53 patients (69.81%) among them most common age group was found to be 31-35 years followed by 36-40years and 25-30 years. We found that most common age group was 31-35 years 13 out of 37(41.93%) followed by 12 patients out of 37 (38.70%) . This suggests that prevalence of disc bulge is highest at 31-35 years.
6. We also found that there were total 88 disc bulge noted out of which 32 disc bulge were noted at C5-C6 inter vertebral level(36.36%) followed by 18 disc bulge were at C4-C5 inter vertebral level (20.45%) . This suggest that most common disc bulge was found at C5-C6 inter vertebral level.
7. Total 29 patients (54%) had spinal canal stenosis out of which 26 patients had mild spinal canal stenosis however 2 patients had severe spinal canal stenosis with myelomalacic changes and 1 patient has moderate spinal canal stenosis, however point prevalence of cervical spinal stenosis at C5-C6 level is 40.32%.
8. Only 3 patients who had disc desiccation below 35 age group however 7 patients had disc desiccation in 36-40 years age group this indicate that disc desiccation was not significantly contributing factor early degeneration with clinical symptom. The point prevalence of disc desiccation at C5-C6 intervertebral level is 30%.
9. We found total only 5 patient had neural foraminal compromise out of 53 patients the point prevalence at C5-C6 level is 9.43% whoever most common level that is affected in neural foraminal compromise is C5-C6 level .
10. There are 16 patient having type II modic changes out of 33 patients (48.48%) at C5-C6 vertebral level, followed by 6 patients at C4-C5 vertebral level. These Type II modic changes are consistent with degenerative changes.
11. Osteophyte spur formation at 24 vertebral levels which contribute to secondary spinal canal stenosis. Out of them prevalence of osteophyte spur formation were maximum at C5 vertebral level which was found to be 9 out of 24 (37%).

CONCLUSION

In this study 53 patients underwent MRI cervical Spine. Out of them 37 patients had degenerative changes in cervical spine in the form of either disc bulge, spinal canal stenosis, neural foraminal compromise, modic changes. Majority of the subjects were males. Hypertension, tobacco use, DM, smoking obesity and sickle cell disease were associated risk factors. There is strong correlation between loss of cervical lordosis and neck pain. We also conclude that among intervertebral levels C5-C6 is the most commonly level that affect in degenerative changes in cervical spine. We also found that degenerative changes are more commonly found in cervical spine in early age group.

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