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ANALYZING THE EFFICACY OF CERVICAL SPINE FINDINGS BY MRI SCAN IN THE PATIENTS SUFFERING FROM CHRONIC NECK PAIN

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ABSTRACT

Background: MRI of the cervical spine can provide valuable information concerning the intervertebral disc, ligaments, muscles, nerve roots, and spinal cord in the region. It can also find anatomical anomalies in the early stages of neck pain subjects.

Aims: The present study was aimed to assess the MRI findings in subjects with neck pain and to assess the role of MRI cervical spine in patients with chronic neck pain

Methods: The study included 50 subjects from both genders with chronic neck pain of >3 months duration. All the subjects had an MRI cervical spine done using a 1.5 Tesla GE EXCITE MR System, which acquired T1W and T2W images in sagittal and axial planes and STIR images in the coronal plane. Various disc and vertebral body parameters were assessed and recorded on MRI. The data gathered were statistically analyzed.

Results: On MRI, Pressure effect on theca and disc bulge was most common and was seen in 80% (n=40) study subjects followed by osteophytes, foramina stenosis, disc herniation, disc protrusion, left foramina stenosis, and right foramina stenosis in 52% (n=26), 48% (n=24), 46% (n=23), 44% (n=22), 42% (n=21), and 40% (n=20) study subjects respectively. Cord compression, central canal stenosis, and intervertebral disc space narrowing were seen in 36% (n=18) of subjects each. Bilateral foramina stenosis was seen in 26% (n=13) study subjects, Modic changes were seen in 22% (n=11) study subjects, disc extrusion in 10% (n=5) study subjects, spondylolisthesis in 6% (n=3) study subjects, and disc sequestration in 2% (n=1) study subjects respectively.

Conclusions: The present study, concludes that MRI is a successful modality for assessing various morphological alterations in cervical spines of subjects with chronic neck pain. Degenerative changes like disc herniation, disc bulge, disc desiccation, intervertebral disc space narrowing, osteophyte formation, neural foraminal stenosis, central canal stenosis, etc are common findings in patients with complaints of chronic neck pain in MRI cervical spine examination. C5-C6 vertebral level is most commonly involved in disc herniation disc protrusion.

Keywords: MRI, neck pain, disc bulge, disc herniation, chronic neck pain

INTRODUCTION

One of the main public health issues that have a large contribution to daily life and work-life impairment and morbidity in affected subjects is attributed to neck pain. Neck pain can negatively affect the psychological, social, and physical well-being of affected subjects along with posing a high financial burden on medical management. The Global Burden of Disease in 2010 ranked neck pain as fourth following depression, arthralgias, and back pain concerning the disability. Neck pain affects more people frequently in middle age and can lead to severe disability in nearly 5% of affected subjects. In societies, discomfort of the neck is gradually becoming a commonly encountered condition.[1]

Acute neck pain is usually resolved spontaneously with no intervention, whereas, in nearly 50% of subjects it can persist longer for a minimum of 12 weeks or >3 months followed by entering to chronic stage, and in

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these conditions, these are diagnosed as chronic neck pain. Two major neck pain causes include degenerative diseases and post-traumatic neck pain. Post-traumatic neck pain is further divided into whiplash syndrome and major injuries. Degenerative diseases leading to neck pain include degenerative disc disease, disc herniation, and spondylosis. Degenerative diseases are also seen following trauma. Other uncommon causes are neoplasms, arteriovenous malformations, vertebral artery dissection, carotid artery dissection, and others.[2]

The most common site of degenerative changes is the cervical spine. The most common spine dysfunction following the fourth decade of life is spondylotic myelopathy which includes a wide range of degenerative changes in the spine. Degenerative changes in the spine are many and disease symptoms largely depend on location and type of changes. After the introduction of MRI (Magnetic resonance imaging), owing to its excellent spatial resolution characteristics and a high degree of soft tissue contrast, it shows precise detail and allows detection of morphological anomalies by the examiners. This increases the detection of the sensitivity of abnormal findings. However, plain radiography depicts valuable information about the cervical spine, and advanced imaging such as MRI and CT (computed tomography) have a vital role in providing accurate diagnosis. To avoid radiation dose in CT, MRI is considered a better assessment option.[3]

MRI in the cervical spine can provide valuable information concerning the intervertebral disc, ligaments, muscles, nerve roots, and spinal cord in the region. MRI can find anatomical anomalies in the early stages. MRI is also useful in surgical planning management in subjects with structural abnormalities. Since MRI is not available in all regions of the country and even in places where tests are available, it is expensive and not affordable for the majority of the Indian population. Few subjects might have significant spinal structural anomalies on MRI with no severe pain, whereas, others might have minimum findings with extensive pain. Also, existing literature data is scarce for MRI findings on chronic neck pain in the Indian context,[4] hence, the present study was aimed to assess the MRI findings in subjects with neck pain and to assess the role of MRI cervical spine in patients with chronic neck pain.

MATERIALS AND METHODS

The present prospective observational study aimed to assess the MRI findings in subjects with neck pain and to assess the role of MRI cervical spine in patients with chronic neck pain. The study was conducted at JLN Hospital and Research Centre, Bhilai, Chhattisgarh, for 18 months. Informed consent was obtained from all the subjects before study participation.

The study assessed 50 subjects of both genders who were referred to the radiology department for an MRI cervical spine with complaints of chronic neck pain during the study period in Jawaharlal Nehru Hospital and Research Centre Sector 9 Hospital Bhilai, Chhattisgarh were included in this study.

For sample size assessment, it was assessed referring to the previous study of Wang XR et al from 2019,[5] following the study, 98.1% of subjects exhibited at least one degenerative change at one or more vertebral levels. Hence,

P=0.981

1.96= z value for 95% significance level

e= Allowable error =0.04.

Cochran formula for observational study.

Minimum Sample Size=$\mathbf{N} = \frac{\mathbf{1.96^2} * \boldsymbol{p} * (\mathbf{1} - \boldsymbol{p})}{\boldsymbol{e^2}} = \frac{\mathbf{1.96^2} * \mathbf{0.981} * (\mathbf{1} - \mathbf{0.981})}{(\mathbf{0.04})^2}$ = 45

The present study included 50 subjects.

The inclusion criteria for the study were subjects having chronic neck pain of duration more than 3 months, subjects aged more than 18 years, and subjects that were willing to participate in the present study. The exclusion criteria for the study were subjects with claustrophobia, and subjects having contraindications for MRI including cardiac implantable electronic devices, aneurysmal clips, and/or metallic implants. The study also excluded subjects having MRI findings of acute spinal infection, recent trauma, and spinal dysraphism.

After the final inclusion of subjects based on chronic neck pain history and strict inclusion and exclusion criteria, approval and clearance were taken from the Institutional Ethical Committee. The data were gathered on preformed structured study proforma to attain demographic data of the subjects including lifestyle, gender, and age. Chronic neck pain duration and radiation were also noted. The presence of motor or sensory deficits in the upper limb was also assessed. MRI findings were also noted.

In all the included subjects, an MRI cervical spine was done using a 1.5 Tesla GE EXCITE MR System with the acquisition of T1W and T2W images in sagittal and axial planes and STIR images in the coronal

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plane. Sagittal T2W also provides a myelographic effect that allows evaluation of spinal cord morphology and the presence of extrinsic compression. Gradient echo sequences were performed in selected cases. Scans were assessed for spondylosis, spondylolisthesis, ligamentum flavum hypertrophy, degenerative vertebral endplates changes, nerve root compression, absence/presence of annular fissure, osteophytes, disc degeneration, and disc herniation which was graded as sequestration, extrusion, protrusion, bulge, and normal disc herniation.

The parameters assessed in study subjects for vertebral disc changes were MRI signal intensity assessed as severely degenerated disc with markedly decreased signal intensity may demonstrate linear areas of high signal intensity on T2W Heavily calcified disc may show regions of decreased or absent signal within. Also, annular tears or fissures, disc desiccation, disc bulge, disc herniation, disc protrusion, disc extrusion, and disc sequestration were assessed. Vertebral body changes are assessed as vertebral body degeneration as broadening or flattening in the anteroposterior direction and Osteophytes or spondylotic changes. Ligament pathologies assessed were calcification, ossification, and hypertrophy of ligaments in the spinal canal as posterior longitudinal ligaments and ligamentum flavum. Facet joint arthropathy, sagittal alignment, spinal canal stenosis, spondylolisthesis, spinal cord compression, atlanto dental distance, enplate changes, and degenerative marrow changes were also assessed.[6-16]

Data were gathered on study proforma and were entered in an MS Excel sheet and analyzed by using SPSS 24.0 version IBM USA. Qualitative data was expressed in terms of percentages and proportions. Quantitative data was expressed in terms of Mean and Standard deviation. Association between two qualitative variables was seen by using Chi-square/ Fischer's exact test. A comparison of mean and SD between the two groups was doneby using an unpaired t-test to assess whether the mean difference between groups was significantor not. Descriptive statistics of each variable were presented in terms of Mean, standard deviation, and standard error of the mean. A p-value of <0.05 was considered statistically significant whereas a p-value of <0.001 was considered highly significant.

RESULTS

Out of 50 patients with chronic neck pain, 32 (64%) were female and 18 (36%) were male. The majority of patients were from the 51-60 years age group i.e. 19 (38%) followed by 41-50 years i.e. 12 (24%) and 7 (14%) from the 61-70 years age group. The mean age of the study subjects was 54.64±12.50 years. The majority of the patients i.e. 30 (60%) with chronic neck pain had an active lifestyle, whereas, 40% (n=20) subjects had sedentary lifestyles. Concerning employment status, the majority of the patients were employed i.e. 19 (38%) followed by 14 (28%) patients as a house maker (Table 1).

The mean pain duration was 5.76±2.54 months with the majority of subjects presenting within 4 months of study with 22% (n=11) subjects followed by 18% (n=9) subjects at 3 months, 16% (n=8) subjects in 5 months, 14% (n=7) subjects in 6 months, 8% (n=4) subjects in 7 months, 6% (n=30 subjects each at 8 and 9 months, 4% (n=2) subjects at 10 months, 2% (n=1) subject each at 11, 12, and >12 months. Most common presenting complaint was chronic neck pain in 100% (n=50) subjects followed by radiculopathy in 40% (n=20) subjects, tingling in 28% (n=14) subjects, weakness/muscle pain in 26% (n=13) subjects, shoulder pain in 20% (n=10), neck stiffness in 18% (n=9), numbness in 16% (n=8), vertigo in 12% (n=6), sphincter dysfunction and trauma in 6% (n=3) each, paraparesis in 4% (n=2) subjects, and Quadriparesis/quadriplegia in 2% (n=1) study subject (Table 2).

MRI findings in study subjects were positive in 88% (n=44) subjects and negative in 12% (n=6) study subjects respectively. Pressure effect on theca and disc bulge was most common and was seen in 80% (n=40) study subjects followed by osteophytes, foramina stenosis, disc herniation, disc protrusion, left foramina stenosis, and right foramina stenosis in 52% (n=26), 48% (n=24), 46% (n=23), 44% (n=22), 42% (n=21), and 40% (n=20) study subjects respectively. Cord compression, central canal stenosis, and intervertebral disc space narrowing were seen in 36% (n=18) of subjects each. Bilateral foramina stenosis was seen in 26% (n=13) study subjects, Modic changes were seen in 22% (n=11) study subjects, disc extrusion in 10% (n=5) study subjects, spondylolisthesis in 6% (n=3) study subjects, and disc sequestration in 2% (n=1) study subjects respectively (Table 3).

On assessing the frequency of abnormal conditions causing neck pain**,** SOL in the spinal cord,trauma, and spondylosis were seen in 2% (n=1), 8% (n=4), and 70% (n=35) study subjects respectively (Table 4).For distribution of Modic changes in study subjects, Modic changes of Type 1, 2, and 3 were seen in 2% (n=1), 16% (n=8), and 4% (n=2) study subjects among a total of 11 subjects with the Modic changes (Table 5).

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Concerning the distribution of study subjects based on disc herniation, disc displacement, and intervertebral disc distance, disc herniation was seen in 48% (n=24) of study subjects. In disc displacement, disc bulge, disc herniation, protrusion, extrusion, and sequestration were seen in 80% (n=40), 48% (n=24), 44% (n=22), 10% (n=5), and 2% (n=1) study subjects respectively. Intervertebral disc level was C2-C3, C3-C4, C4-C5, C5-C6, C6-C7, and C7-T1 in 10% (n=5), 28% (n=14), 48% (n=24), 74% (n=37), 54% (n=27), and 10% (n=5) study subjects respectively (Table 6).

DISCUSSION

The present study included a total of 50 patients in our study. Female predominance was seen in our study with 64% and males with 36%. Female to male ratio was 1.7: 1. Mean age of the patients was 54.66±12.52 years. Safdari et al[17]conducted a cross-sectional study in 2014 in the city of Sistan and Baluchestan, South East of Iran which included 700 patients. In this study 67.7% were female and 32.3% were male. Female predominance was seen as similar to our study. The average age of them was 35.62±10.15 years. Islam MK et al[18]conducted an MRI evaluation of neck pain in 60 patients in which male to female ratio was 3:1.

The majority of patients in this study were from the 51-60 years age group i.e. 19 (38%), followed by the 41-50 years i.e. 12 (24%), and 7 (14%) from the 61-70 years age group. This suggests that neck pain was predominantly common in middle age group and elderly population. Rikke Krüger Jensen et al[19] found a similar pattern in which most of the patients who had neck pain were in the 51-60 years age group (187 out of 611 patients) followed by 41-50 years (135 patients). S. A. Olarinoye-Akorede et al[20]found the highest frequency of presentation of neck pain in the 41-50 years age group.

The mean duration of chronic neck pain in this study was 5.76±2.54 months. Most of the patients had symptoms for 4 months (22% cases). Associate with chronic neck pain one or more other symptoms were also presented in patients. The most common complaint was radiculopathy (40%) followed by tingling sensation (28%) and muscle pain/weakness (26%). History of trauma was present in 6% of cases. Olarinoye-Akorede et al[20]also reported radiculopathy in 65 cases (50%), numbness in 52 cases (40%), a trauma in 39 cases (30%). Safdari et al[17]reported chronic neck pain in 44 (6.3%) cases with a history of trauma and shoulder pain was the most common complaint (8.7%) Islam MK et al[18]reported left and right brachialis in 18.3% and 13.3% cases respectively as most common complains. History of trauma was presented in 2 (03.3%) cases.

The study results showed that normal MRI cervical spine in 6 (12%) cases and positive findings in the rest 44 (88%) cases. Spondylosis (degenerative changes) accounted for 35 (70 %) of the radiological findings in patients with chronic neck pain. Spondylolisthesis was seen in 3 (6%), osteophytes in 25 (50 %), Modic changes in 11 (22%), Disc desiccation in 23(46%), and Intervertebral disc space narrowing in 18 (36%) cases. Safdari et al[17]reported spondylosis in 47 (6.7%), Disc Dehydration in 4 (0.6%), and osteophyte in 28 (4%). Islam MK et al[18]assessed normal MRI cervical spine in patients with chronic neck pain in 2 (03.3%) cases and positive findings in 42 (96.7%) cases. Disc desiccation changes were seen in 40 (66.7%), and Wang XR et al[5]found inosteophytes in 96. 8% (30/31) male and 93.5% (29/31) female patients with neck pain in their study

S. A. Olarinoye-Akorede et al[20]reportedspondylosis in 42 (60.1%), osteophytosis in 94 (72.3%), disc dehydration in 68 (52.3%), spondylolisthesis 7 (14.6 %) and Disc narrowing in 32 (24.6%) cases. R. Deepu et al[21] reported disc degeneration in 23.9% of cases in their study which was in agreement with the results of the present study.

The study results depicted modic changes in 11 (22%) patients in different vertebral body levels in our study, among which type 2 was most common (16%) followed by type 3 (4%) and type 1(2%). Krüger Jensen et al[19]also reported type 1 Modic changes in 25% of cases followed by type 2 in 6% of cases.

In the present study, disc bulging was seen in 40 (80%), disc herniation in 24 (48%), protrusion in 22 (44%), Extrusion in 5 (10%) and sequestration in 1(2%) patients. Safdari et al[17]found disc bulging in 136 (19.4%), disc protrusion in 221 (31.6%), and disc extrusion in 5 (0.7%) cases. Islam MK et al[18]reported disc protrusion in 8 (13.3 %) and disc extrusion in 4 (6.7 %) patients in their study. Wang XR et al[5]reported disc herniation in 54.8% (17/31) males and 64.5% (20/31) females with neck pain. S. A. Olarinoye-Akorede et al[20]reported disc herniation in 88 (67.7%) patients. R. Deepu et al[21]reported posterior disc protrusion in 50.9% of patients.

It was also seen foraminal stenosis in 28 (56%) patients, out of which 3 (26%) had bilateral foraminal stenosis, 21 (42%) had left foraminal stenosis and 20 (40%) had right foraminal stenosis. Central canal stenosis was present in 18 (36%) patients. We also found space occupying a lesion in the cervical canal in

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one patient. Islam MK et al[18]bilateral foraminal canal stenosis in 30 (50%), left foraminal canal stenosis in 17 (28.3%) and right foraminal canal 14 (23.3%) and central canal stenosis in 30 (50%) patients. Safdari et al[17]reportedbilateral foraminal canal stenosis in 35 (5%), left foraminal canal stenosis in 10 (1.4%) and right foraminal canal 11 (1.6%). Wang XR et al[5]reported spinal canal stenosis in all patients with neck pain (N = 31/31, 100%). S. A. Olarinoye-Akorede et al[20]reported foramina stenosis in 51 (39.2%) patients in their study. R. Deepu et al[21]reported foraminal stenosis in 27.9% of patients. Krüger Jensen et al[19]also reported central canal stenosis in 38% cases.

Pressure effect on theca seen in Islam MK et al[18] in 40 (80%) patients in our study. Also found these in 50 (83.3%) patients and Safdari et al[17] **were** found in 61 (8.7%) patients in their study. In our study, cord compression was seen in 18 (36%) patients. S. A. Olarinoye-Akorede et al[20] also found cord compression in their study, in 69 (53.1%) patients. In our study, C5-C6 (N=37, 74%) level was most commonly involved in intervertebral disc level in patients with chronic neck pain followed by C6-C7 (N=27, 54%) and C4-C5 (N=24, 48%) level. The least common involved levels were C7-D1 and C2-C3. Islam MK et al[18]found similar findings in which the C5-C6 level was most commonly involved **(**78.3 %) followed by the C6-C7 level (63.3%) Safdari et al[17]found abnormal disc findings more in C3-C4 level in 23.7% patients followed by C4-C5 level in 22% patients. R. Deepu et al[21]found Disc degeneration maximum at the C5-6 level and least at the C7-D1 level.

CONCLUSION

The present study, within its limitations, concludes that MRI is a successful modality for assessing various morphological alterations in the cervical spines of subjects with chronic neck pain. Degenerative changes like disc herniation, disc bulge, disc desiccation, intervertebral disc space narrowing, osteophyte formation, neural foraminal stenosis, central canal stenosis, etc are common findings in patients with complaints of chronic neck pain in MRI cervical spine examination. C5-C6 vertebral level is most commonly involved in disc herniation disc protrusion. However, in the future, further multi-institutional studies with larger sample sizes are warranted.

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TABLES

Characteristics	**Number (n)**	**Percentage (%)**
Gender		
Males	18	36
Females	32	64
Mean age (years)	54.64±12.50	
Age range (years)		
19-30	2	4
31-40	4	8
41-50	12	24
51-60	19	38
61-70	7	14
71-80	5	10
>80	1	2
Lifestyle		
Sedentary	20	40
Active	30	60
Employment		
Unemployed	1	2
Student	2	4
Senior citizen	10	20
Homemaker	14	28

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Self-employed	4	8
Employed	18	38

Table 1: Demographic data on study participants

Parameters	**No of patients (N)**	**Percentage (%)**
Pain duration		
3 months	9	18
4 months	11	22
5 months	8	16
6 months	7	14
7 months	4	8
8 months	3	6
9 months	3	6
10 months	2	4
11 months	1	2
12 months	1	2
>12 months	1	2
Total	50	100
Min-Max	3-13	
Mean ± SD	5.76±2.54	
Median	5	
Chief complaints		
Chronic neck pain	50	100
Tingling	14	28
Numbness	8	16
Radiculopathy	20	40
Vertigo	6	12
Neck stiffness	9	18
Shoulder pain	10	20
Weakness/muscle pain	13	26
Paraparesis	2	4
Quadriparesis/quadriplegia	1	2
Sphincter dysfunction	3	6
Trauma	3	6

Table 2: disease data in study subjects

MRI Findings	**No of patients (N)**	**Percentage (%)**
Normal Finding	6	12
Positive findings	44	88
Osteophytes	26	52
Modic changes	11	22
Disc Desiccation	23	46
Intervertebral disc space narrowing	18	36
Disc Bulge	40	80
Disc Herniation	24	48
Disc Protrusion	22	44
Disc Extrusion	5	10
Disc Sequestration	1	2
Foramina Stenosis	28	56
Bilateral foramina stenosis	13	26
Right foramina stenosis	20	40
Left foramina stenosis	21	42

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Central canal stenosis	18	36
Pressure effect on theca	40	80
Cord compression	18	36
Spondylolisthesis	3	6

Table 3: MRI findings in study subjects

Conditions	No of patients (N)	Percentage (%)
Spondylosis	35	70
Trauma	4	8
SOL in the spinal cord	1	2

Table 4: Frequency of abnormal conditions causing neck pain

Modic changes	No of patients (N)	Percentage (%)
Type 1	1	2
Type 2	8	16
Type 3	2	4
Total	11	22

Table 5: Distribution of Modic changes

Parameters	No of patients (N)	Percentage (%)
Disc herniation		
Present	24	48
Absent	26	52
Disc displacement		
Disc bulge	40	80
Disc herniation	24	48
Protrusion	22	44
Extrusion	5	10
Sequestration	1	2
Intervertebral disc level		
C2-C3	5	10
C3-C4	14	28
C4-C5	24	48
C5-C6	37	74
C6-C7	27	54
C7-T1	5	10

Table 6: Distribution of study subjects based on disc herniation, disc displacement, and intervertebral disc distance