

## Role of MRI in Non-Traumatic Neck Pain With or Without Cervical Radiculopathy

Acharya S<sup>1</sup>, Pokharel S<sup>2</sup>

1. Associate Professor, Department of Radiodiagnosis, Devdaha Medical College and Research Institute

2. Assistant Professor, Department of Radiodiagnosis, Lumbini Medical College, Prabhas, Palpa

### ABSTRACT

**Introduction:** Neck pain is the primary causes of disability worldwide and more common in a low socioeconomic country like Nepal. Magnetic Resonance Imaging (MRI) is now extensively used as the imaging modality to reveal diseases and abnormalities of the cervical vertebrae and the intervertebral discs. The objective of this study was to evaluate the role of MRI in the diagnosis of causes of neck pain and to document the pattern of findings seen in patients who presented with non-traumatic neck pain with or without radiculopathy in our setup.

**Method:** This was a cross-sectional study conducted in the Department of Radio diagnosis, Lumbini Medical College and Teaching Hospital (LMCTH), Pravas, Palpa, Nepal during the six months period from 1st March 2022 to 31st August 2022.

**Results:** A total of 70 MRI examinations of the cervical spine were included in this study. Cervical spondylosis was the commonest cervical spine abnormality found in 59 (84.2%) patients followed by disc bulge in 54 (77.1%) subjects. Disc herniation including protrusion, extrusion and sequestration were seen in 8 (11.4%) cases. Disc bulge/disc herniation caused spinal canal stenosis in 46 (65.7%), neural foraminal stenosis in 45 (64.2%) cases and spinal cord signal changes in 12 (17.1%) subjects. Disc degeneration and prolapse were most prevalent at C4-C5 level. There were non-degenerative causes of neck pain in 9 (12.8%) patients .

**Conclusion:** Degenerative cervical spine findings were the most common MRI patterns seen in symptomatic patients in this study.

**Keywords :** Cervical vertebrae, Degenerative changes, Magnetic Resonance Imaging, Neck pain, Radiculopathy

### Introduction

Neck pain can be defined as the sensation of discomfort in the area of the neck that is bounded by the occiput superiorly, the second thoracic vertebra inferiorly, and the ends of the scapular spines laterally.<sup>1</sup> It can result from disorders of any of the structures in the neck, including the cervical vertebrae, intervertebral discs, ligaments, joints, dura, spinal cord, nerves, muscles, blood vessels, esophagus, larynx, trachea.<sup>2,3</sup> Neck pain, along with low back pain, are the leading causes of disability world wide.<sup>4</sup> The largest increase in

disability caused by neck pain has been appreciated in low- and middle-income countries in Asia, Africa, and the Middle east<sup>5</sup> In a low-income country like Nepal the prevalence of neck pain was estimated to be 12.3% in a study conducted in 2018.<sup>6</sup>

The cervical spine has the most spinal mobility with as much as 600 movements per hour in a normal individual, thus it has high susceptibility to degenerative changes.<sup>7,8</sup> Cervical spondylosis with cervical radiculopathy is a common indication for MRI (Magnetic Resonance Imaging) of the cervical spine, however evaluation of other causes of neck pain like infective spondylodiscitis, neoplastic disease, congenital conditions like Chiari malformation, block vertebra, basilar invagination are

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Corresponding author:  
Dr. Sumnima Acharya  
Lumbini Medical College, Pravas, Palpa.  
Phone: 9779857051149  
Email: radiologistsumnima@gmail.com

also assessed by the help of cervical MRI for better patient's management.<sup>9</sup>

Cervical spondylosis is a degenerative process of the spine which alone or in combination with other factors like disc herniation, facet joint degeneration, ligamentum flavum hypertrophy may result in narrowing of the central spinal and root canals causing radiculopathy. It is a very common cause of radiculopathy with progressing age but degenerative changes are also noted in earlier age group.<sup>10,11,12</sup>

It is impossible to detect and accurately diagnose many causes of neck pain such as disk prolapse, nerve entrapment and spinal cord compression on conventional radiographs and computed tomography (CT).<sup>13</sup>

MRI has a high diagnostic accuracy and it has superior soft tissue differentiation and ability to detect lesions within the bone marrow, the spinal cord and the intervertebral disc (IVD) and it has no radiation hazards so MRI is now widely used as the imaging modality of choice to demonstrate diseases and abnormalities of the spinal column and the intervertebral discs.<sup>14</sup>

The most commonly used sequences for imaging cervical spine are axial and sagittal T1, T2WI and STIR images. Contrast T1W in axial, sagittal and coronal plane are only done in complicated conditions like infective, inflammatory and neoplastic conditions.<sup>12</sup>

No study has been conducted so far in this part of our country to know the exact causes of neck pain. The objectives of this study was to evaluate the role of MRI in the diagnosis of causes of neck pain and to document the pattern of findings seen in patients who presented with non-traumatic neck pain with or without radiculopathy in our setup.

## Method

This was a cross-sectional study conducted in the Department of Radio diagnosis, Lumbini Medical College and Teaching Hospital (LMCTH), Pravas, Palpa, Nepal. The study was conducted after the ethical approval from the Institutional Review Committee (IRC-LMC 01-E/021) of the hospital during the six month period from 1<sup>st</sup> March 2022 to 31<sup>st</sup> August 2022

## Sample Size and Sample Technique

According to the prevalence rate of 12.3% in a study done in Bhaktapur district<sup>3</sup> and a confidence level of 95% and power of 90%, the required sample size was calculated using the formula

$$n = t^2 \times p(1 - p) / m^2$$

n = required sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated prevalence of cervical pain. = 12.3% = 0.12  
m for power of 90% = margin of error at 10% (1 - alpha) = 0.1  
Sample size =  $(1.96)^2 \times 0.12(1 - 0.12) / (0.1)^2 = 3.8 \times 0.12 \times 0.88 = 0.40 = 36.4$

Required minimum sample size = 37

This is calculated for a confidence level of 95% and power of 90%.

## MR imaging protocol

The images were acquired with the help of SIEMENS SEMPRA MAGNETOM 1.5 Tesla MRI scanner. Dedicated surface coil for cervical spine was used. Imaging was done with patient in a supine position. The various MR imaging sequences are:

Axial and Sagittal T2WI

Axial and Sagittal T1WI

Sagittal STIR

Post contrast T1 axial, sagittal and coronal in special cases<sup>12</sup>

After acquisition of images, findings of each subject were recorded in an individual case proforma. The case proforma contained all informations regarding the general particulars like: name, age, sex, clinical details and MRI findings. The information collected regarding all the selected cases were recorded in a Master Chart.

## Statistical analysis

The information retrieved from the database was then statistically analyzed using a statistical package for social sciences SPSS version 25. Tables were tabulated for illustrations. We used simple descriptive statistics in the form of means, frequencies, and percentages.

## Inclusion and exclusion criteria

MRI of cervical spines were done in all patients who were referred to the Radiology department for MRI with history of non-traumatic neck pain with or without radiculopathy. Patients with a clinical history of trauma to the neck, cardiac pacemakers, metallic implants, and claustrophobic patients were completely excluded from this study.

## Definitions

**Normal intervertebral disc:** Disc material that poses all the normal anatomical features on MRI.

**Desiccation/dehydration:** Loss of hyperintense signal of the nucleus pulposus on T2-weighted images.

**Bulge:** Diffuse displacement of disc material beyond the limits of the intervertebral disc.<sup>15</sup>

**Herniation:** (Protrusion, Extrusion and Sequestration): Protrusion is when the height of the hernia (in the axial

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slice) is less than the length of the base in any of the planes (Figure 1). Extrusion is when the length of the base is less than the height of the hernia (Figure 2), while sequestration is when there is no continuity between the herniated material and the intervertebral disc (Figure 3).<sup>16,17</sup>



Figure 1. Protrusion: base greater than height



Figure 2. Extrusion: height greater than base



Figure 3: Sequestration: no continuity with the disc.

**Cervical radiculopathy:** It is characterized by neurological dysfunction caused by compression and inflammation of the spinal nerves or nerve roots of the cervical spine. It mainly presents with neck and arm pain, sensory loss, motor dysfunction, and reflex changes according to the dermatomal distribution.<sup>18</sup>

### Results

A total of 70 MRI examinations of the cervical spine were included in this study. There were 37 (52.9 %) females and 33 (47.1%) males (female:male = 0.8:1). The mean age was 46.8±12.8 (range between 25-77 years). Participants in age range of >40 years were 45

(64.3%), whereas ≤ 40 yrs were 25 (35.7%). No abnormalities were found on MRI among 11(15.71%) patients while remaining 59 (84.28%) had abnormality in MRI scan.

**Table 1: Distribution of the study participants by different pathology of cervical spine (n=70).**

Different cervical pathology*	No.	%
Cervical Spondylosis (CS)	59	84.2
IVD (Intervertebral disc) degenerative changes	57	81.4
Disc Bulge	54	77.1
Disc herniation	8	11.4
Spinal canal stenosis	46	65.7
Neural foraminal stenosis	45	64.2
Spinal cord signal change	12	17.1
Non degenerative findings	9	12.8

\*Cervical spine pathologies were not mutually exclusive, total percentages may exceed 100 %.

Cervical spondylosis was the commonest cervical spine abnormality in 59 (84.2%) patients followed by disc bulge in 54 (77.1%). Disc herniation including protrusion, extrusion and sequestration in 8 (11.4%) cases. Most of the abnormalities of cervical spine were associated with IVD degenerative changes in 57 patients (81.4%). Disc bulge/disc herniation caused spinal canal stenosis in 46 (65.7%) and neural foraminal stenosis in 45 (64.2%), spinal cord signal changes in 12 (17.1%). There were non-degenerative causes of neck pain in 9 (12.8%) patients (Table 1).

**Table 2: IVD (Intervertebral disc) degenerative findings**

IVD degenerative Findings	No.	%
Disc desiccation	26	45.6
Disc osteophyte complex with desiccation	31	54.3
Total	57	100.0

Out of 70 patients, total disc desiccation was found in 57 (81.4%). Among 57 cases disc desiccation alone was found in 26 (45.6%) and in combination with disc osteophyte complex in 31 (54.3%). (Table 2)

Table 3: Cervical Level of disc degeneration and prolapse

Cervical Level	No.	%
C2-C3	1	1.4
C3-C4	18	25.7
C4-C5	20	28.5
C5-C6	5	7.1
C6-C7	3	4.2
Multiple levels	12	17.1
Normal	11	15.7
Total	70	100

Disc degeneration and prolapse was most prevalent at C4-C5 level (20;28.5%) followed by C3-C4 (18;25.7%) levels. Multiple levels were involved in 12 (17.1%). C2-C3 is the least involved disc. 11 (15.7%) cases were normal. (Table 3)

Table 4: Non degenerative causes of cervical pain

Other Findings	No.	%
Neoplasm	2	2.8
Spondylolisthesis	1	1.4
Block Vertebra	1	1.4
Chiari Malformation	1	1.4
Infective Spondylodiscitis likely TB	4	5.7

Among 70 total cases of neck pain, we had non degenerative causes of neck pain in 9 cases. Among 9 cases, 4 cases had infective spondylodiscitis (5.7%), 2 had neoplasm (2.8%) (1-Glioma, 1-mets), one had spondylolisthesis (1.4%), one case had block vertebra (1.4%), one had Chiari Malformation (1.4%). (Table 4)

## Discussion

In our study, a total of 70 MRI examinations of the cervical spine were included. There were 37 (52.9%) females and 33 (47.1%) males. Most of the studies we

reviewed made no reference to gender variation<sup>19</sup>, although study done in Southern Nigeria showed male preponderance<sup>20</sup>. In contrast, the meta-analysis by Hoy et al.<sup>5</sup> and another study done in Ethiopia<sup>21</sup> found a higher prevalence of neck pain among females than males same as that of ours possibly due to engagement of females in more physically demanding activities.

The findings from our study showed that degenerative vertebral and intervertebral disc disease affects all age groups ranging from 25-77 years though more common in >40 years (64.3%) and mean age of the study group was 46.8±12.8 years. There were similar finding in previous retrospective studies done in Nepal and Nigeria on patients with neck pain that undergo cervical spine MRI evaluation showing degenerative changes such as intervertebral disc desiccation and bulge to have increased prevalence with age.<sup>22,23</sup>

Disc height reduction and disc desiccation occurs as a result of dehydration of the inner nucleus pulposus. Disc prolapse occurs as a result of the already compromised annulus fibrosus permitting the degenerating nucleus pulposus to migrate and this can be seen as bulging of the disk material in its mildest form to migration in severe cases. With all these processes occurring simultaneously and progressively, there may be an exacerbation of the symptoms of neck pain and findings of spinal cord and nerve compression.<sup>14</sup> Cervical spondylosis was the commonest cervical spine abnormality in 59 (84.2%) patients followed by disc bulge in 54 (77.1%). Disc herniation including protrusion, extrusion and sequestration in 8 (11.4%) cases. Most of the abnormalities of cervical spine were associated with IVD degenerative changes in 57 patients (81.4%). Our results are in concordance with the study published in 2014<sup>22</sup>, 2021<sup>15</sup>, 2023<sup>20</sup>, 2021<sup>21</sup>. Out of 70 patients, disc desiccation was found in 57 (81.4%). Among 57 cases; disc desiccation alone was found in 26 (45.6%) and in combination with disc osteophyte complex in 31 (54.3%) case. The findings are in consistent with previous study done in Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia.<sup>21</sup>

Tuberculous spondylitis most commonly affects the thoraco-lumbar spine, followed by the thoracic spine, but is rare in the cervical region and comprises only 2-3% of all cases of TB spine.<sup>24</sup> Our study reported four (5.7%) cases of tuberculous spondylitis in the cervical region, all presenting with neck pain and a few with radiculopathy similar to the report done in University of Maiduguri Teaching Hospital.<sup>22</sup> We also documented other causes of neck pain like neoplasm (2-2.8%)

among which one case was glioma and one was metastasis, spondylolisthesis (1-1.4%), block vertebra (1-1.4%), Chiari Malformation (1-1.4%). The findings are comparable to the previous prospective studies done in Ethiopia<sup>21</sup>.

Neural foramina and spinal canal stenoses were seen in 45 (64.2%) and 46 (65.7%) patients respectively. Imaging findings suggesting spinal cord compression with signal change were seen in 12 (17.1%) patients. These findings are in consistent with previous study done in 2018.<sup>21</sup>

Cervical spines 3-7 are considered to be the motion segments of the C-spine with mobility being maximal at C5/C6 level.<sup>23</sup> In our study disc degeneration and prolapse was most prevalent at C4-C5 level (20;28.5%) followed by C3-C4 (18;25.7%) levels similar to the findings in the studies done in Nigeria.<sup>15,22,2</sup>

In our study, among 70 cases of cervical pain, 11 (15.7%) patients had normal results. A study carried out on 170 symptomatic patients in Nigeria showed 14 (9.4%) to have normal results<sup>22</sup>. A study carried out on 342 symptomatic patients in Iran showed 73 (21.3%) to have normal results<sup>7</sup>. Few researchers believe that the technical or inherent faults or shortcomings of an MRI scanner may be responsible for inability to detect some structural changes, thus documenting these cases as normal.<sup>25</sup> The absence of abnormal imaging findings in these patients may be related to different nonstructural factors including psychosocial, nutritional and might be due to neuropathy due to other systemic diseases like diabetes mellitus.<sup>21</sup>

### Conclusions

Degenerative cervical spine findings were the most common MRI patterns seen in patients with non-traumatic neck pain with or without radiculopathy in this study showing increasing prevalence with age and C4-C5 is the most commonly involved intervertebral disk level. Nondegenerative imaging findings such as neoplasm and infection were less common findings.

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