

## Original Research Article

# Pattern of cervical disc changes in patients with non-traumatic neck pain: a review of cervical MRI scan findings

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### ABSTRACT

**Background:** Neck pain is a common global health problem causing significant individual disability and socioeconomic burden on health care facilities. Many factors have been associated with neck pain but the most implicated is the cervical intervertebral disc disease. Magnetic resonance imaging (MRI) scan is considered globally as the most sensitive test for detecting degenerative disc abnormalities associated with neck pain. The objective of this study was to evaluate cervical disc changes on MRI in non-traumatic symptomatic subjects and to accumulate baseline data on the pattern of changes.

**Methods:** A four-years retrospective review of 115 patients (age range 13 to 81 years) who had a cervical MRI scan due to non-traumatic neck and radiating shoulder pain from September 2017 to February 2021 at the Radiology Department of Jos University Teaching Hospital North Central Nigeria. All the patients were scanned using a Single Siemens (Magnetom Concerto) MRI scanner with 0.2T magnetic field strength. Sagittal T1-weighted and T2-weighted fast spin-echo images were acquired, and axial images and contrast-enhanced studies were done only when required.

**Results:** The study included 74 (64.3%) males and 41 (35.7%) females with a mean age of  $50.7 \pm 13.2$  and a modal age group of 41-60 years. The normal intervertebral disc was commonest at C2/C3 followed by C6/C7 level while degenerative disc changes were most commonly seen at C4/C5 followed by C5/C6 level. The majority (93%) of patients had multilevel intervertebral disc changes and the most frequent and severe occurrences of intervertebral disc dehydration, bulge, herniation, and disc space narrowing were noted at C4/C5 (79.1%), C4/C5 (12.2%), C5/C6 (59.1%) and C4/C5 (10.4%) respectively.

**Conclusions:** This study found all patients examined had at least one level of intervertebral disc changes with the majority having multilevel involvement (93%). The most commonly and severely affected level was C4/C5 followed by C5/C6 level. The most frequent and severe occurrences of disc desiccation, bulge, herniation (protrusion/extrusion/sequestration) and disc height reduction were noted at C4/C5 (79.1%), C4/C5 (12.2%), C5/C6 (59.1%) and C4/C5 (10.4%) respectively.

**Keywords:** Neck pain, Cervical disc, Degeneration

### INTRODUCTION

Cervical intervertebral disc disease is a common cause of neck and radiating upper limb pains globally. The socioeconomic and psychological impact of neck pain is a

huge burden to individuals and the community. In 2010, the Global burden of disease study identify neck pain as the fourth leading cause of years lost to disability.<sup>1</sup> Acute neck pains may resolve spontaneously without any intervention but about half, the individuals may have

residual or recurrent pain up to twelve months after the initial complaints.<sup>1</sup>

The cervical spine is the most mobile part of the spine with over 600 movements per hour in a normal individual and the maximum flexion and extension occur at C5/C6 disc level.<sup>2-4</sup> The Intervertebral disc (IVD) is a very complicated structure that plays a very vital role in the movement of the spine and is comprised of two parts, the tough but flexible outer Annulus fibrosus (AF) and centrally located Nucleus pulposus (NP) which is responsible for shock absorption and prevent vertebral bone friction.

Degenerative changes involving the intervertebral disc are a common entity in the spine with increasing occurrence with an increase in age.<sup>5</sup> It has been strongly implicated as a major risk factor in patients presenting with neck and radiating upper limb pains.<sup>6</sup> The mechanism of change has been related to a combination of biomechanical stress and genetic predisposition which alters the structural and metabolic integrity of the disc.<sup>1</sup> Several studies have also shown a strong relationship between disc degeneration with an increase in age. Other risk factors associated with this condition include obesity, smoking, and other environmental factors.<sup>4,7-10</sup>

Magnetic resonance imaging (MRI) scan is considered globally as the most sensitive test for detecting degenerative disc abnormalities associated with neck pain. Other imaging modalities include conventional plain radiography and Computed tomography (CT) scan.

On MRI, the early stages of intervertebral disc degeneration and its course can be evaluated with the T2-weighted image (WI) sequence playing a vital role.

The objective of this study was to evaluate the pattern of cervical intervertebral disc changes with age and gender in patients presenting with non-traumatic neck and radiating upper limb pains and to compare it with local and other international findings.

## METHODS

A four-years retrospective review of 115 patients (age range 13 to 81 years) who had cervical MRI scans due to non-traumatic neck and radiating upper limb pain from September 2017 to February 2021 at the radiology department of Jos University Teaching Hospital.

A Single Siemens (Magnetom concerto) MRI scanner with 0.2T magnetic field strength in Sagittal T1-weighted and T2-weighted fast spin-echo images were acquired and axial images and contrast-enhanced studies were done only when required. The scan reports from the departments' database were evaluated for age, sex and radiological findings after ethical approval was obtained from ethical and research review committee of the hospital.

## Statistical analysis

The information retrieved from the database was then statistically analysed using a statistical package for social sciences SPSS version 23. Tables and bar charts were extracted for illustrations; we also employed simple descriptive statistics in form of means, frequencies, and percentages

## Inclusion criteria

All patients of either gender with a clinical history of non-traumatic neck and radiating shoulder pain had cervical spine MRI evaluation at the radiology department were included.

## Exclusion criteria

Patients with a clinical history of trauma to the neck were excluded.

## Definitions

### Normal intervertebral disc

Disc material that poses all the normal anatomical features on MRI.

### Desiccation/dehydration

Loss of hyperintense signal of the nucleus on T2-weighted images.

### Bulge

Diffuse displacement of disc material beyond the limits of the intervertebral disc.

### Hernia

Focal displacement of disc material beyond the limits of the intervertebral disc.

## RESULTS

The average mean age for male subjects was 52.6±13.7 years while that of the females was 47.2±11.8 years. The overall mean age of subjects was 50.7±13.2 years. It also reveals that most males (52.7%) and females (70.7%) respectively, were between ages 41-60 years. There was a statistical difference in the sex and age distribution of the subjects (p<0.05) (Table 1).

It was discovered that 8 (7.0%) were single while a majority of the subjects, representing 93.0% had multiple level involvement (Table 2). Normal intervertebral disc morphology was noted more at C2/C3 (32.2%) followed by C6/C7 (27.8%) when compared to other discs. On the other hand, disc C4/C5 (79.1%) and C3/C4 (73.0%)

showed higher desiccation than other discs. Disc bulge was recorded more in disc C4/C5 (12.2%). Herniation was seen more in disc C5/C6 (59.1%) compared to other discs. The clinical presentation revealed that the overwhelming majority (96.5%) presented with pain, while 4 (3.5%) presented with poor movement respectively (Table 3 and 4).

**Relationship between sex and pattern of cervical disc changes**

At C2/C3 disc level, there was no significant difference between males and females. At disc C3/C4, female participants had significantly higher (54.5%) normal disc pattern compared to their male counterparts (45.5%) (p=0.040). On the other hand, male participants (71.4%) had higher desiccation at C3/C4 than their female counterparts (28.6%). This difference was statistically

significant (p=0.009). Similarly, at C5/C6 disc level, the majority of the participants representing 71.1% that had disc desiccation were male compared to their female counterparts (28.9%). This difference was statistically significant (p=0.015) (Figure 1).

**Relationship between age and pattern of cervical disc changes**

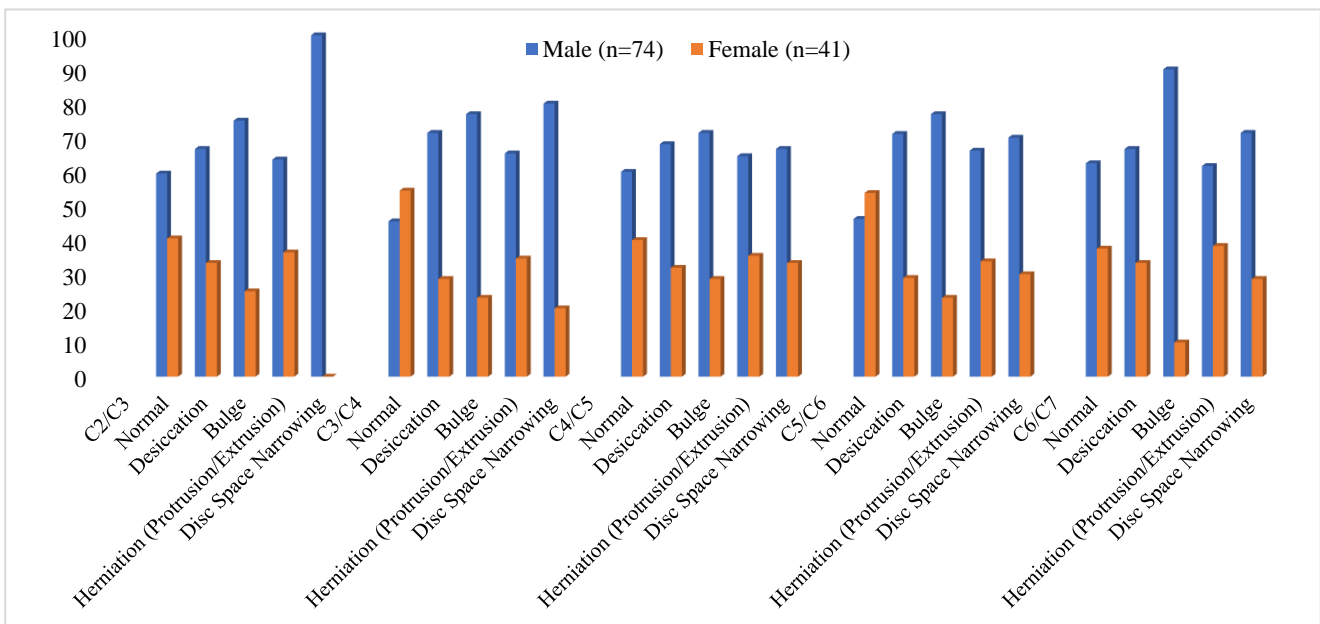
It was discovered that the majority of the participants (75.7%) who had normal disc pattern at C2/C3 were between ages 41-60 years. This difference was statistically significant (p=0.000). Similarly, half (51.3%) of the participants who had desiccation were between ages 41-60 years (p=0.000). At C3/C4, C4/C5, C5/C6 and C6/C7 about half (53.6%), (53.8%), (54.2%) and (54.7%) of participants respectively who had desiccation where between ages 41-60 years (p<0.05) (Figure 2).

**Table 1: Age and sex distribution of subjects (N=115).**

Age group of participants (years)	Male		Female		Total		Chi-square	P value
	N	%	N	%	N	%		
≤20	1	1.4	2	4.9	3	2.6		
21-40	15	20.3	8	19.5	23	20.0		
41-60	39	52.7	29	70.7	68	59.1		
61-80	18	24.3	2	4.9	20	17.4		
>80	1	1.4	0	0.0	1	0.9		
Mean±SD	52.6±13.7		47.2±11.8		50.7±13.2		9.505	0.017

**Table 2: Distribution of subjects by level.**

Levels	F	%
Single	8	7.0
Multiple	107	93.0
Total	115	100.0



**Figure 1: Relationship between sex and pattern of cervical disc changes.**

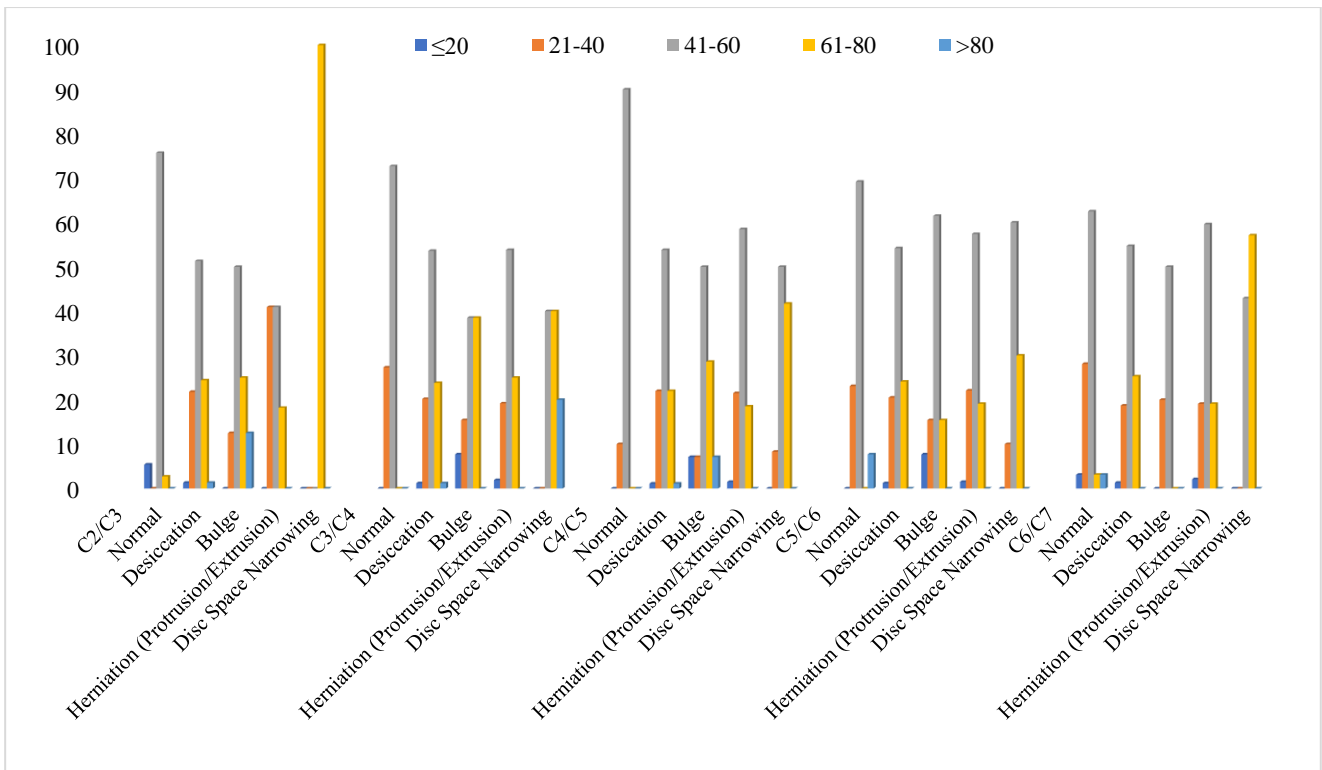


Figure 2: Relationship between age and pattern of cervical disc changes.

Table 3: Distribution of subjects by intervertebral disc pattern (N=115).

Disc patterns	C2/C3		C3/C4		C4/C5		C5/C6		C6/C7	
	F	%	F	%	F	%	F	%	F	%
Normal	37	32.2	22	19.1	10	8.3	13	11.3	32	27.8
Desiccation	78	67.8	84	73.0	91	79.1	83	72.2	75	65.2
Bulge	8	7.0	13	11.3	14	12.2	13	11.3	10	8.7
Herniation (protrusion/extrusion)	22	19.1	52	45.2	65	56.5	68	59.1	47	40.9
Disc space narrowing	1	0.9	5	4.3	12	10.4	10	8.7	7	6.1

Table 4: Clinical presentation.

Clinical presentation	F	%
Pain	111	96.5
Poor movement	4	3.5
Total	115	100.0

**DISCUSSION**

Non-traumatic neck and radiating upper limb pains are a major public health problem globally and cervical intervertebral disc disease has long been implicated as a significant culprit. There are very few studies available that examine the pattern of disc level involvement in patients’ presentation with these pains. MRI scan is the investigation of choice which provides a non-invasive evaluation of the intervertebral disc with excellent image contrast.

Our study shows a male preponderance with an overall male to female ratio of 1.8:1 which is similar to previous

studies conducted in other parts of Nigeria.<sup>2,11,12</sup> However, there is a complete reversal when compared with studies done in Finland by Mäkelä et al and Wang et al in Honkong.<sup>13,14</sup> The male pre-ponderance in Nigeria could be a result of the cultural difference where the male gender is expected to provide for the family and involvement in more physical activity when compared with the female gender.

The findings from our study show that intervertebral disc disease affects all age groups though more common in the older ages. The majority of our patients are within the 41-60 years bracket, and the youngest patient is 13 years old. These agree with the assertion that the disease progression

involves a combination of genetic and environmental factors.<sup>9,15-17</sup>

Abnormal changes in the intervertebral disc usually start with desiccation/dehydration and then displacement of disc material beyond the intervertebral disc space which may be diffuse (bulging) or focal herniation (protrusion, extrusion, and extrusion with sequestration). All the cervical intervertebral discs were examined except for C1/C2 and C7/T1 disc levels. Changes were noted in at least one-disc level in the patients examined. Eight patients (7%) and 107 (93%) had single and multiple disc level involvement respectively.

As previously documented, our study showed a higher percentage of the normal disc at C2/3 and C6/C7 levels in the patients examined.<sup>15,16,18</sup> Our findings showed that cervical disc degeneration is very common in our environment and the most frequently affected level is C4/C5 followed by C5/C6 disc level. These findings are consistent with previously documented works in Nigeria, but differ from that documented by Akinobu et al in Japan who showed C3/C4 level as the most affected and others who showed higher effect at C5/C6 level.<sup>2,12,16,18,19</sup>

Our study also shows more frequent disc desiccation affecting C4/C5 disc level followed by C3/C4 with C6/C7 being the least affected. Intervertebral disc bulge and disc space narrowing were commonly seen at C4/C5 levels followed by C5/C6 level and C2/C3 level being the least affected. Disc herniation which includes protrusion, extrusion and extrusion with sequestration was commonly seen at C5/C6 followed by C4/C5 level and least seen at C2/C3 level. These findings are similar to previously documented studies.<sup>2,12,15,17</sup>

There were several potential limitations in the present study. First, the duration and degree of the neck and radiating shoulder pain were not available to evaluate the relationship between the degree of disc changes with presenting complaints. Secondly, the number of patients aged 61 years and above was relatively small which could be a result of low life expectancy in our environment. Thirdly, details of socioeconomic and environmental factors of the patients were not available in this study which could affect the disc changes. Despite these challenges, we believe that the outcome of this research work will improve the understanding of the pattern of cervical disc changes with clinical presentation in our environment

## CONCLUSION

Our study found that all patients examined had at least one level of intervertebral disc changes with the majority having multilevel involvement (93%). The most commonly and severely affected level was C4/C5 followed by C5/C6 level. The most frequent and severe occurrences of disc desiccation, bulge, herniation (protrusion/extrusion/sequestration) and disc

height reduction were noted at C4/C5 (79.1%), C4/C5 (12.2%), C5/C6 (59.1%) and C4/C5 (10.4%) respectively.

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