

# Frequency of Disc Degeneration at Different Levels of Cervical Vertebrae in Adult Patients with Neck Pain on Magnetic Resonance Imaging

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## Abstract

**Background:** Disc degeneration is terminology used for heterogeneous changes affecting the anatomy and physiology of the intervertebral disc. Disc degeneration alters the material properties of the intervertebral disc leading to an unfavorable distribution and transmission of stress to adjacent spinal structures. **Objective:** The aim of the study was to determine the frequency of disc degeneration at different level of cervical vertebrae in adult patients with neck pain on magnetic resonance imaging. **Methodology:** In this descriptive study 180 adult patients were included. All patients had been collected from DHQ hospital Gilgit and Ghurki Trust teaching hospital. After informed consent, data were collected through 1.5 tesla GE (closed bore) and 0.35 tesla Hitachi (open bore) MRI machines. **Results:** Findings show that among 180 adult patients, 136 presented with disc degeneration among which 81 were males and 55 were females. Among 81 males, 63 had disc degeneration at multiple levels while 18 had single disc degeneration. In females 35 patients showed multiple disc degeneration while 20 involved a single disc. **Conclusion:** It is concluded that disc degeneration is prevalent in males than females. Disc degeneration at multiple levels is higher than single disc degeneration in both genders.

**Keywords:** Disc degeneration, magnetic resonance imaging, intervertebral disc.

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## 1. Introduction

Neck pain is prevalent in the general population. It constitutes that about 30% of the population of people affected by persistent pain<sup>1</sup>. there are many factors that cause neck pain. Factors related to health that elicit neck pain are previous pain episodes, pain in body regions related to the neck, and physical and mental exhaustion. factors other than health includes age and gender<sup>2</sup>. One of the structure that elicit neck, upper extremity pain and headache include cervical intervertebral disc<sup>3</sup>. cervical vertebral disc is consider as one of the most common source of neck pain<sup>4</sup>. pain from disc is thought to originate from annular tears or disc degeneration (DD)<sup>5</sup>. The prevalence of disc degeneration is found to be 14% in individuals less than 40<sup>6</sup>. there are 25 intervertebral disc that lie between the adjacent surfaces of the vertebra uniting them from the axis to the sacrum with 6 disc in the cervical region<sup>7</sup>. The most important function of the intervertebral disc is mechanical: it transmit loads, dissipates energy and help in mobility of joint<sup>8</sup>. The intervertebral discs comprises of two main structures separated by cartilaginous end plates the inner structure is nucleus pulposus and the outer is annulus fibrosus<sup>9</sup>. The annulus fibrosus consist of 15-25 coaxial collagen rings Within each ring, the collagen fibers align parallel and are oriented at approximately 60° to the vertical axis. The outer most layers are most compact and rigid to tensile force. These layers are tightly linked to the endplates and the vertebral bodies and are supported by the posterior and anterior longitudinal ligaments. The areas between the rings are filled with elastin due to elastin the disc return to its initial position after flexion or extension. The nucleus pulposus is quit different from the annulus because its density and consistency of a gel is much less. It is composed of thin, type II collagen and irregularly shaped radially arranged elastin. These hold the gel-like area, which contains proteoglycan molecules that have hydrophilic chondroitin and keratin sulfate attached to them<sup>10</sup>. The vertebral endplate is a thin layer of dense, subchondral bone adjoining to the intervertebral disc. the density and thickness increases towards the edges of vertebra according to some authors inferior, posterior, and lateral regions are strongest while some says that central region below nucleus is strongest. there is a significant variation in strength of end plates<sup>11</sup>. IVD is largest avascular tissue in the body. the cells of annulus fibrosus is supplied by the capillaries around the soft tissues of the disc the remaining cells within the receive their blood supply arise in the vertebral bodies, that pass through the subchondral plate and ends in loops next to the cartilaginous endplate<sup>12</sup>. The intervertebral disc is innervated by the cervical sinuvertebral nerve as it moves upward through vertebral canal it supply the disc at level of its entry and disc present above it the lateral aspects of cervical disc is innervated by the vertebral nerve<sup>13</sup>.

Disc degeneration is common incident but there is no universally proved definition of disc degeneration. according to surgeons and radiologists disc is degenerated if osteophytes are present and signal intensity is lost on MRI. to a biochemist disc is considered degenerated if changes occur in content of proteoglycans or water. If disc

is dry, having cracks and fissures pathologist consider disc is degenerated<sup>14</sup>. Disc degeneration and its related pathologies such as disc herniation has multiple etiologies comprise of genetic and environmental factors. mechanical factors such as lifting of heavy weight and way of living such as lack of exercise .injuries due to lifting of heavy loads and use of tobacco also consider as cause of disc degeneration<sup>15</sup>.

The aim of this study is to observe cervical disc degeneration on MRI in adult symptomatic patients to provide data on frequency of cervical disc degeneration at different levels of cervical vertebrae. This will help the technologist or technician to focus on the exact area from where the problem is being originated rather than scanning the whole cervical spine when obtaining an X ray.

## 1.1 Methods

In this descriptive cross sectional study, 180 adult patients with neck pain were included all the patients had been collected from DHQ hospital Gilgit and Ghurki trust teaching hospital Lahore. After informed consent data were collected through 0.3 Tesla Hitachi and 1.5 Tesla GE MRI machines. Patients having neck pain with no history of trauma, surgery and age greater than 14 were included. Cervical intervertebral disc degeneration including disc protrusion, disc bulge, and decrease in height of disc and signal loss were identified if present. T1, T2, STIR, axial and sagittal sequences were used to obtained images of the cervical spine.

### 1.1.2 Discussion:

Neck pain is fairly prevalent in the adult population which may be due to pathological or age related intervertebral changes. The incidence of cervical degenerative diseases rises with increasing age and cervical disc degeneration (IVDD) is identified to be the main cause of spine disorders which result in neck pain as reported by Pinjie Chen, Chunlei Wu<sup>16</sup>. In the present descriptive study, out of 180 patients having neck pain 110 were males and 70 were females with their age ranging from 14 years to 83 years. Cervical disc degeneration was present in 136 (75.6%) individuals out of which 81 were males and 55 were females. Disc degeneration at multiple levels was seen in 63 males and 35 females while single disc degeneration was present in 18 males and 20 females. In this study we found that disc degeneration at single level was most common at C5-C6 followed by C6-C7 which is in agreement with a study by Morio Matsumoto et. al who studied 497 asymptomatic subjects to evaluate disc degeneration<sup>17</sup>. In the present cross sectional study disc degeneration at two levels were most common at the level of C5-C6, C6-C7 and second most common was at C4-C5, C5-C6 and was least at C4-C5, C7-D1. Suzuki et. Al (2018), analyzed the pattern of cervical disc degeneration in 1059 symptomatic patients and concluded that single level degeneration was more common in C5-C6, C4-C5 and C6-C7 respectively. Multilevel degeneration mostly occurred in C5/C6 & C6/C7 followed by C4-C5 & C5-C6 and C3-C4 & C4-C5. Continuous level of degeneration was more common as compared to skip level degeneration. C7-T1 and C2-C3 were rarely involved in multilevel degeneration. Middle cervical region C5-C6 was most commonly affected with degenerative changes<sup>6</sup>. In our study, multi-level disc degeneration is more frequent than single level disc degeneration. After analysis of data in the present study it is found that C4-C5, C5-C6, C6-C7 was most affected in individuals having disc degeneration at three levels of cervical vertebra and C2-C3, C3-C4, C4-C5 was rarely affected. Degeneration at four different levels of vertebra was common at the level of C3-C4, C4-C5, C5-C6, and C6-C7. Chul Hun Kim conducted a magnetic resonance study of cervical spine in 92 patients with neck pain to evaluate the severity of disc degeneration and disc protrusion and reported that abnormal degenerative changes at more than one disc was seen in a total of 88 (95.7%) patients. No patient had any degeneration at the C2-C3 disc; but 9 (39.13 %) had a protruding C3-C4 disc, 52 patients (56.52%) had a protruding C4-C5 disc and 45 patients (65.22%) presented with C5-C6 or C6-C7 disc protrusion<sup>18</sup>.

The current study shows that in patients with single level degeneration, there was none in which the C2-C3 level was affected. 5 patients (13.2%) had degeneration changes at the C3-C4 level and 3 patients (7.9%) at C4-C5 level degeneration while 23 patients (57.8%) and 7 patients (18.4%) demonstrated degenerated changes at C5-C6 and C6-C7 levels respectively.

Nakashima et al (2015), carried out a study on 1211 healthy subjects to determine the frequency and distribution of abnormalities of cervical on MRI the age of subjects ranged from 20 to 70 years. Their study concluded that disc bulging was most commonly seen in about 87.6% subjects. Spinal cord compression was seen to mainly occur at single level 58% or two level 38% mostly affecting C5-C6 (41%) and C6-C7 (27%). These abnormalities increased with age in frequency and severity<sup>19</sup>. In our present study results conclude that multilevel disc degeneration was present in 98 patients (54.4%) and 38 patients (21.1%) had single level disc degeneration. Both studies also demonstrate that C5-6 and C6-7 were the most commonly degenerated levels and that C2-3 and C7-D1 were rare to show degenerative changes.

### 1.1.3 Conclusion

It is concluded that disc degeneration is prevalent in males than females. Disc degeneration at multiple levels is higher than single disc degeneration in both genders.

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Table 1 shows gender and number of Discs Degenerated

		Number of Discs					Total
		0	1	2	3	4	
Gender	Female	15 21.4%	20 28.6%	20 28.6%	10 14.3%	5 7.1%	70 100.0%
	Male	29 26.4%	18 16.4%	29 26.4%	23 20.9%	11 10.0%	110 100.0%
Total		44 24.4%	38 21.1%	49 27.2%	33 18.3%	16 8.9%	180 100.0%

Table 1 shows the number of disc degenerated in males and females. Single disc degeneration was present in 20 females and 18 males. 20 females and 29 males had disc degeneration at 2 levels while 10 female and 23 males had degeneration at 3 levels. Disc degeneration at four levels was present in 5 females and 11 males.

Table 2 shows disc degeneration at single level

	Frequency	Percent
C3-C4	5	13.2
C4-C5	3	7.9
C5-C6	23	57.8
C6-C7	7	18.4
Total	38	100.0

Table 2 shows the frequency of disc degeneration at single level of cervical vertebrae. It shows that frequency of C3-C4 is 5; C4-C5 is 3; C5-C6 is 23; and C6-C7 is 7. C5-C6 is most commonly degenerated disc at single level. Table 3 shows Disc Degeneration at two vertebral levels

	Frequency	Percent
C3-C4,C4-C5	6	12.2
C3-C4,C5-C6	4	8.1
C3-C4,C6-C7	8	16.3
C4-C5,C5-C6	11	22.4
C4-C5,C7-D1	1	2.0
C5-C6,C6-C7	19	38.8
Total	49	100.0

Table 3 shows the frequency of disc degeneration at two different levels of cervical vertebrae. The frequency of degeneration at C3-C4,C4-C5 was 6, C3-C4,C5-C6 is 4, C3-C4,C6-C7 was 8, C4-C5,C5-C6 was 11, C4-C5,C7-D1 was 1 and C5-C6,C6-C7 was 19. Disc C5-C6, C6-C7 were the most commonly degenerated discs.

Table 4 shows Disc Degeneration at three levels of vertebra

	Frequency	Percent
C2-C3,C3-C4,C4-C5	1	3.0
C3-C4,C4-C5,C5-C6	9	27.3
C3-C4,C5-C6,C6-C7	7	21.2
C4-C5,C5-C6,C6-C7	16	48.5
Total	33	100.0

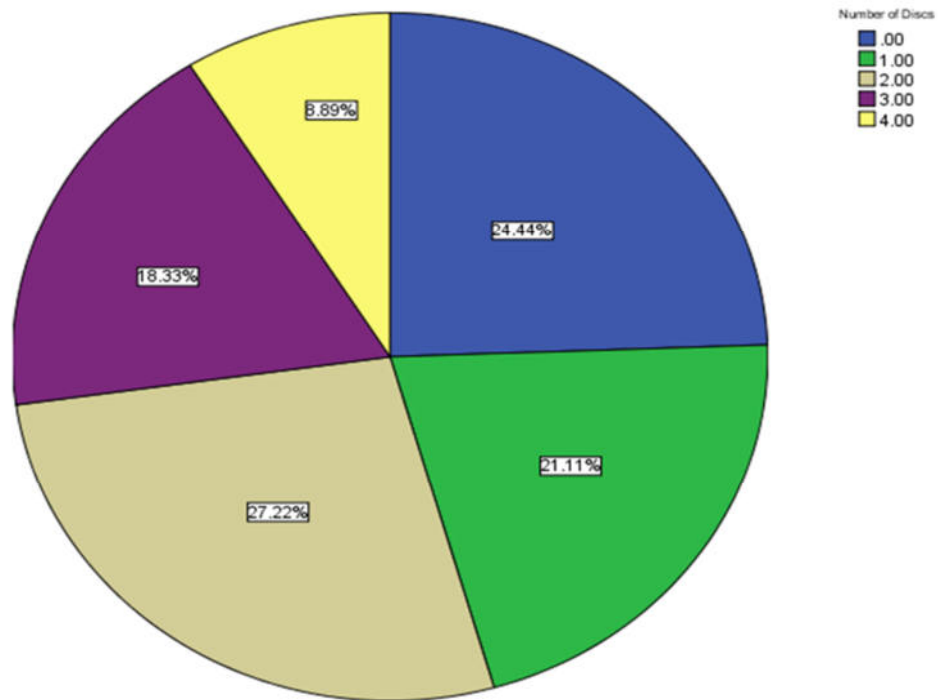
Table 4 shows the frequency of disc degeneration at three different levels of cervical vertebrae. The frequency of degeneration at C2-C3,C3-C4,C4-C5 was 1; at C3-C4,C4-C5,C5-C6 was 9; at C3-C4,C5-C6,C6-C7 was 7 and at C4-C5,C5-C6,C6-C7, which was found to be the most common, was 16

Table 5 shows discs degeneration at four vertebral levels.

	Frequency	Percent
C2-C3,C3-C4,C4-C5,C5-C6	2	6.2
C3-C4,C4-C5,C5-C6,C6-C7	11	68.8
C4-C5,C5-C6,C6-C7,C7-D1	3	18.8
Total	16	100.0

Table 5 shows that the frequency of C2-C3,C3-C4,C4-C5,C5-C6 is 2, C3-C4,C4-C5,C5-C6,C6-C7 is 11 and C4-C5,C5-C6,C6-C7,C7-D1 is 3.

Pie chart



The pie chart below shows the percentages of the number of disc degenerated. There was no disc degeneration in 24.44% patients while 21.11% had disc degeneration at a single level. Disc degeneration at 2 levels was present in 27.22% and 18.33% patients had degeneration at 3 levels. Degeneration of disc at 4 levels were present in 8.89% of patients.