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ORIGINAL ARTICLE

Pattern of cervical magnetic resonance imaging findings in diagnosed cases of degenerative disc disease among adult patients with persistent neck pain

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ABSTRACT

Background: Degenerative disc disease is a common word for the condition in which an injured vertebral disc leads to chronic pain, 40% of people aged 40 years or above have disc degenerative disease. This increases to 80% in people aged 80 years or above. The present study assessed the pattern of cervical magnetic resonance imaging findings in diagnosed cases of degenerative disc disease.

Methods: A cross-sectional study was conducted on 441 patients with persistent neck pain who are suspected of having degenerative intervertebral disc disease, and who had underwent a cervical spine magnetic resonance imaging interpreted by a consultant radiologist at Al-Qassim national hospital using a 1.5 Tesla magnet. The cases were collected through a picture archiving and communication system from January 2018 to January 2020. The Chi-square test was carried out for data analysis.

Results: Degenerative disc disease in diffuse disc bulge and protrusion was found in all of the study subjects accounting for 441; diffuse disc bulge was the commonest degenerative change found in 306 subjects (69.4%), followed by protrusion found in 126 (28.6%). C5-C6 was the most common level for degenerative disc disease accounting for 46.9%. All results of age-related degeneration were non-significant, except the correlation between age and disc osteophyte complex. All results of sex-related degeneration were non-significant.

Conclusion: Disc degeneration and the changes associated had no associations to either sex.

Keywords: Chronic neck pain, cervical disc degeneration, cervical MRI.

Introduction

The cervical spine is a site known to develop injuries due to high mobility that helps neck movements [1]. Furthermore, neck pain mostly runs as episodes over a person's lifetime. Thus, relapses are common. Moreover, it is generally a joint presentation, especially in office workers and good-income individuals compared to lower-income individuals [2]. The mean prevalence of neck pain in the general population is (23.1%) [2], and of those neck pain presentations, 40% of people aged 40 have degenerative disc disease. This increases to 80% in people aged 80 years [3]. Moreover, degenerative disc disease is a common word for the condition in which an injured vertebral disc leads to chronic pain, either low back pain in the lumbar spine or neck pain in the cervical spine [1]. In addition, degenerative disc disease is a many-sided continuous irreversible condition and an unavoidable part of ageing, and it might cause

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radiculopathy, myelopathy, spinal stenosis, degenerative spondylolisthesis, and herniation [4].

Degeneration in the intervertebral disc starts during the 4th decade in both sexes. With age progression, degeneration gets worse [5]. Okada et al. [6] conducted a cervical magnetic resonance imaging (MRI) of 497 healthy individuals and found that the prevalence of disc degeneration increased with age. It showed a decrease in signal intensity of intervertebral disc in 86% males and 89% females aged 60-69 years.

The X-ray was the only modality of choice to image the spine in the past. This modality is limited in describing disc structures and measurements of the spine due to overlapping anatomical images. Currently, MRI provides an accurate image of soft tissue and bony structures, enabling us to catch an accurate abnormality with good sensitivity [5]. These days, MRI is the best modality of choice to image intervertebral discs. The early steps of disc degeneration show a decrease in signal intensity on T2-weighted images [4]. The present study aims to evaluate the characterization, extent, and pattern of degenerative cervical disc disease by MRI. Further to know the most common degenerative cervical disc disease findings by cervical spine MRI. The study also targeted to determine the relationship between age & sex to the degenerative cervical disc disease by a cervical spine MRI.

Subjects and Methods

A cross-sectional study on a total of 441 patients with persistent neck pain that are suspected of degenerative intervertebral disc disease underwent a cervical spine MRI; 225 male (51%) and 216 females (48.9%) with ages ranging from 28 to 81 years old distributed as less than 30 and 30 or more they were diagnosed and studied by a consultant radiologist at AL-Qassim national hospital using a 1.5 Tesla magnet (General electronic) with the following sequence; Sagittal T2, Sagittal T1, Axial T2, Axial T1, Coronal T2, and sagittal STIR T2. The cases were collected through a picture archiving and communication system from January 2018 to January 2020. Some criteria have been excluded, such as trauma, infection, inflammatory processes, and neoplastic changes. Oral and written consent has been obtained from all the patients, and they have no issues with the study.

We used patient demographic data and classified them according to gender and age groups less than 30 and 30 years or more. We calculated frequency distributions and used the Chi-square test to analyze the relationship between abnormal findings and patient characteristics. A p-value less than 0.05 was kept in mind to indicate statistical significance. MRI findings were diffuse disc bulge, protrusion, extrusion, straightening, desiccation, Modic type endplate changes, effect to the relative nerve roots, narrowing of the neural foramen, narrowing of the spinal canal, and disc osteophyte complex.

Results

Four hundred forty-one patients were studied and evaluated by a cervical MRI of clinically suspected degenerative intervertebral disc disease. Two hundred twenty-five males (51%) and 216 (48.9%) female patients. The age of the patients ranged from 28 to 81 years, with a mean age of 41.7 years. The maximum number of patients (51%) was in the fourth decade. All results of age-related degeneration were non-significant, except the correlation between age and disc osteophyte complex (for more details see Table 2). All results of sex-related degeneration were non-significant (for more details see Table 3). Degenerative disc disease in diffuse disc bulge and protrusion was found in all study subjects accounting for 441. Diffuse disc bulge was the most typical degenerative change found in 306 (69.4%), followed by protrusion found in 126 (28.6%). The C5-C6 was the most common level for degenerative disc disease accounting for 46.9% represented in Table 1.

Diffuse disc bulge had a p-value of 0.184, disc protrusion had a p-value of 0.314, and disc extrusion had a p-value of 0.900 (illustrated in Figure 5).

Correlated with sex; diffuse disc bulge had a p-value of 0.830; correlated with sex, disc protrusion had a p-value of 0.588; correlated with sex, disc extrusion had a p-value of 0.322 (illustrated in Figure 2).

Discussion

Intervertebral discs are composed of a pulpy semifluid center, the nucleus pulposus, and a strong outer layer called the annulus fibrosus. With disc degeneration, small tears appear in the annulus fibrosus, causing bulging of the nucleus pulposus. This causes the disc to bulge past the boundaries of the vertebral bodies leading to narrowing of the spinal canal (illustrated in Figure 3).

Changes associated with degenerative disc disease include abnormal strains on the vertebral bodies leading to osteophyte formation, facet joint arthropathy. These changes may lead to narrowing the spinal canal ending

Table 1. *Level for degenerative disc disease.*

Level	Prevalence, *n* (%)
C2/3	9 (2)
C3/4	36 (8.2)
C4/5	72 (16.3)
C5/6	207 (46.9)
C6/7	198 (44.9)

Table 2. *Incidence of degenerative disc findings categorized by age.*

		Less than 30	30 and more	% of the study population	*p*-value
Straightening		27	279	69.3	0.481
Desiccation		18	360	85.7	0.418
Narrowing of the spinsal canal		0	63	14.2	0.472
Disc osteophyte complex		0	99	22.4	0.002
Modic type endplate changes	Type 1	0	9	2.04	0.079
	Type 2	0	54	12.2	0.079
Effect on the relative nerve roots	Touching the nerve roots	18	171	42.8	0.615
	Encroaching the nerve root	9	99	24.4	0.615
	Compressing the nerve root	0	63	14.2	0.615
Narrowing of the neural foramen	Moderate Narrowing	18	180	44.9	0.653
	Moderate to severe narrowing	9	90	22.4	0.653
	Severe narrowing	0	63	14.2	0.653

Table 3. *Incidence of degenerative disc findings categorized by sex.*

		Male	Female	% of the study population	*p*-value
Straightening		162	144	69.3	0.686
Desiccation		180	198	85.7	0.243
Narrowing of the spinal canal		27	36	14.2	0.641
Disc osteophyte complex		36	63	22.4	0.269
Modic type endplate changes	Type 1	9	0	2.04	0.418
	Type 2	18	36	12.2	
Effect on the relative nerve roots	Touching the nerve roots	90	99	42.8	0.760
	Encroaching the nerve root	54	54	24.4	
	Compressing the nerve root	27	36	14.2	
Narrowing of the neural foramen	Moderate Narrowing	90	108	44.9	0.707
	Moderate to severe narrowing	54	45	22.4	
	Severe narrowing	27	36	14.2	

in spinal canal stenosis [8]. Furthermore, disc protrusion is when the nucleus pushes through the annulus and squeezes out of the disc [9] (illustrated in Figure 4).

A disc extrusion is when the protrusion extends above or below the disc level and is associated with herniation of the nucleus pulposus beyond the confines of the disc [11].

Disc dehydration is a regular part of ageing. It comes after replacing the hydrophilic glycosaminoglycans within the nucleus pulposus with fibrocartilage, and the result is decreased disc height [13] (illustrated in Figure 6).

First described in 1988, Modic type endplate changes delineate a classification for vertebral body endplate MRI signal and is further classified into: Modic type 1 changes: T1: low signal; T2: high signal. Modic type 2 changes: T1: high signal; T2: iso to high signal. Modic type 3 changes: T1: low signal; T2: low signal [15].

Bony spur-like formations called Osteophytes are a characteristic feature of degenerative disc diseases. The purpose of osteophyte is unclear even though it is regarded as the body trying to re-balance the weight-bearing of the spine to recover the degenerated disc. The formation of osteophytes beside a degenerated disc is often connected with causing compression of the nerves and spinal cord

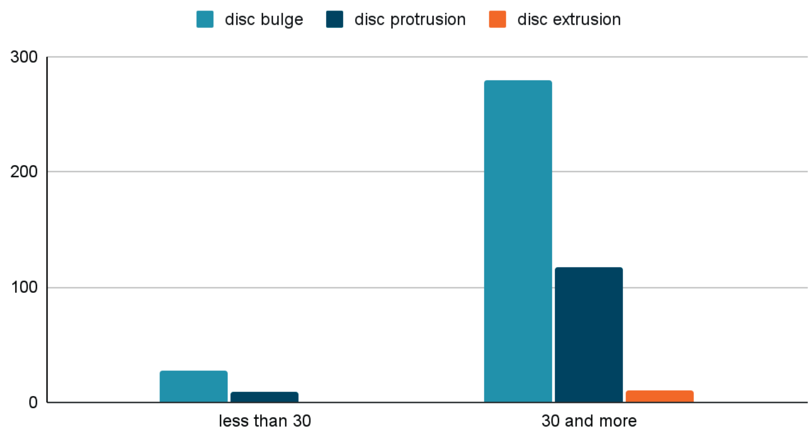

Figure 1. *Correlation between age and cervical degenerative disease.*

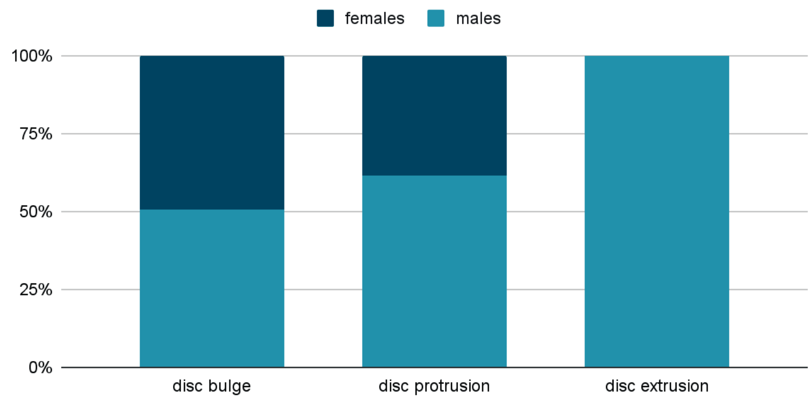

Figure 2. *Correlation between sex and cervical degenerative disease.*

[16,17]. Cervical neural foraminal stenosis is a gradual narrowing of the intervertebral foramina that may cause nerve root inflammation, impingement, or both, which could cause cervical radiculopathy. Furthermore, it may result from degenerative osteophytes, facet hypertrophy, or laterally herniated discs [18]. Few studies examine cervical disc degeneration concerning age and sex to the best of author' knowledge. Our study found that the disc degeneration with disc changes is more commonly found at (C5/6) 46.9% and (C6/7) 44.9%. Levels when compared to a previous study done by Suzuki et al. [4] they conducted an MRI study of 1,059 patients with neck pain and reported that disc degeneration is most common in the middle cervical spine (C5/6) 51.2% with (C6/7) 16.7% and progresses to contiguous levels.

We found that the most prevalent disc degenerative disease was diffuse disc bulge (69.4%), in contrast to a previous study done by Karki et al. [1], who conducted an MRI study of 750 patients, which reported a percentage of (49.3%). The most common age of incidence of disc degenerative disease in our study is observed in the fourth and fifth decades of life, similar to a number of other studies concerned with degenerative disc disease and its relation to age [4,6]. In this study, we established no relation between degenerative disc disease and sex. This is supported by Karki et al. [1] study results. There is a significant correlation between age and cervical disc degeneration of disc osteophyte complex only as its incidence increased with age; other results were non-significant.

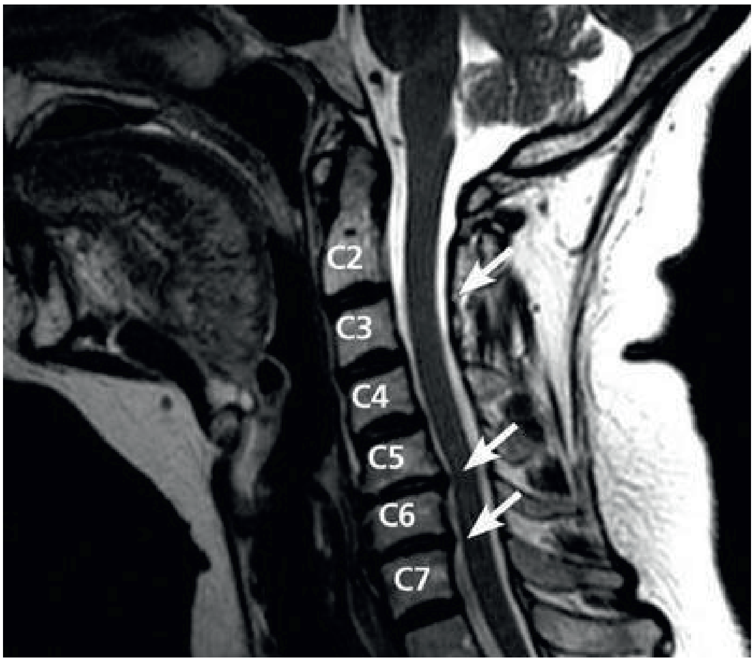

Figure 3. *MRI Sagittal T2 MRI shows disc bulge at C5/6 and C6/7 [7].*

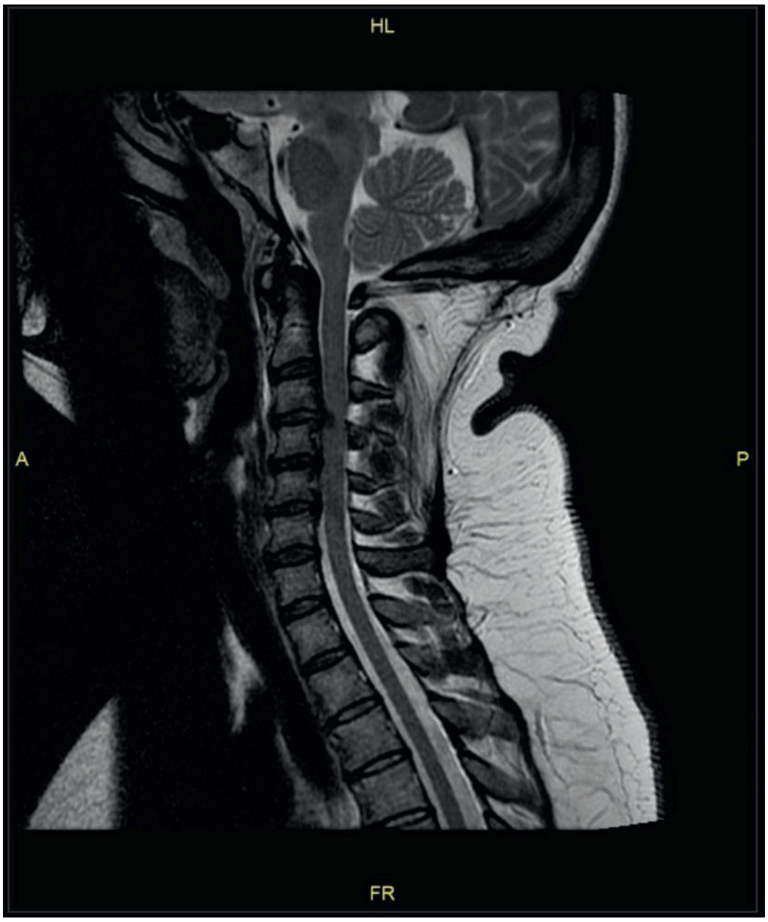

Figure 4. *Sagittal T2 MRI shows large C3/C4 left paracentral disc protrusion compressing the left side of the cord. Furthermore, disc osteophyte complex at C5/C6 caused a moderate bilateral foraminal stenosis with Moderate left foraminal stenosis at C6/C7 [10].*

Figure 5. *Sagittal T2 MRI shows a large extruded disc at C5/6 on the left side, resulting in severe canal stenosis [12].*

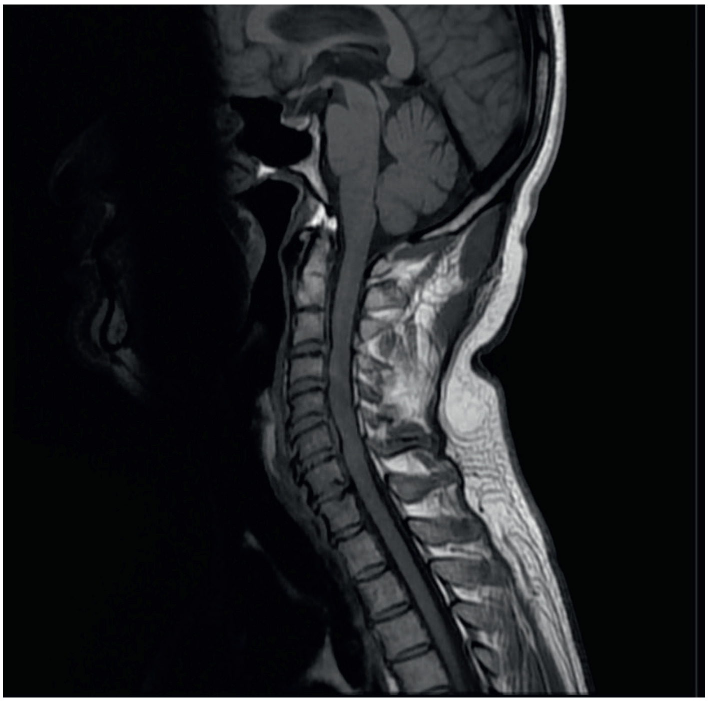

Figure 6. *Sagittal T1 MRI shows straightened cervical spine with preserved alignment and Multilevel disc dehydration (decreased disc height) [14].*

Conclusion

Diffuse disc bulge was the most common finding followed by disc protrusion in the studied patients, specifically after 30 years. We found that the disc degeneration is most common at the cervical level (C5/6). Disc degeneration and the changes associated had no leaning to either sex.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Funding

None.

Consent to participate

Written informed consent was obtained from all the participants.

Ethical approval

The present study was approved by the ethical committee of the general directorate of health affairs in Al-Qasim region vie reference number (1443-810634) dated 2021/12/6.

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