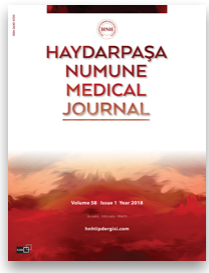
HAYDARPAŞA NUMUNE MEDICAL JOURNAL

DOI: 10.14744/hnhj.2024.94758
Haydarpasa Numune Med J 2024;64(4):479–485



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ORIGINAL ARTICLE

Relationship Between Clinical Symptoms and MRI Findings in Patients with Cervical Degenerative Disc Disease

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Abstract

Introduction: Degenerative cervical disc disease is a disorder that often presents with various symptoms, and diagnosis is frequently challenging. The aim of this study is to identify the symptoms of degenerative cervical disc disease and evaluate the relationship between symptoms and radiological findings.

Methods: The study was designed as a cross-sectional and observational study. Fifty-five consecutive patients diagnosed with degenerative cervical disc disease were included in the study. The symptoms were recorded, and the relationship between cervical MRI findings and symptoms was investigated.

Results: A total of 55 patients were included in the study. Of these, 32 (58.2%) were female and 23 (41.8%) were male, with a mean age of 56.3±12.9 years. Cervicogenic headache (27.3%), retroorbital pain (20%), tinnitus (3.6%), trigeminal neuralgia (14.5%), dizziness (14.5%), neck pain (89.1%), restricted neck movement (83.6%), neck paresthesia (14.5%), shoulder pain (36.3%), restricted shoulder movement (16.3%), shoulder weakness (12.7%), pain radiating to the upper extremity (41.8%), sensory deficit in the upper extremity (18.2%), weakness in the upper extremity (9.1%), and back pain (34.5%) were recorded in the patients. The most remarkable finding in patients with pathology at the C2-C4 level was trigeminal neuralgia, while trigeminal neuralgia was not observed in patients with pathology at the C4-C8 level. Dizziness, neck pain, and restricted neck movement were common symptoms, with sensory and motor symptoms predominating in lower cervical signs. Statistically significant higher rates of upper cervical symptoms were recorded in radiological grade 2 and 3 changes, while lower cervical symptoms were significantly higher in grade 3 and 4 changes.

Discussion and Conclusion: The most common degenerative finding observed in patients was located in the middle cervical region. Neck pain was the most frequently reported symptom. The most remarkable unusual finding was trigeminal neuralgia, which was observed in upper cervical discopathies. Symptoms were recorded to be associated with the severity of radiological findings.

Keywords: Cervical discopathy; symptoms; upper cervical MRI findings.

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Submitted Date: 18.02.2024 **Revised Date:** 31.03.2024 **Accepted Date:** 13.06.2024
Haydarpaşa Numune Medical Journal

Cervical degenerative disc disease is a condition that results from the degeneration of intervertebral discs, leading to compression of the spinal canal or impingement of nerve roots, often as a consequence of natural aging [1,2]. A recent review on the epidemiology of cervical degenerative disc disease revealed prevalence rates ranging from 4% to 30% in Africa, 22% in Australia, 31% in Europe, 54% in the United States, and 59% in Japan, with a prevalence of 1,120 per million [3].

Cervical degenerative disc disease is continuously increasing due to factors such as car use, traffic accidents, widespread use of computers, and increased dependence on mobile phones. Pain, numbness, hypersensitivity in the neck and upper extremities, impaired fine motor function of the hands, difficulty in rapid movements of the lower extremities, and abnormal reflexes are the main symptoms of the disease [4,5]. Unfamiliar symptoms such as dizziness, tinnitus, nausea, ear/eye/throat pain, imbalance, and hearing loss are often overlooked due to the lack of recognition of upper cervical symptoms [6,7]. The lack of recognition of symptoms of upper cervical degenerative disc disease leads to missed diagnoses, resulting in unnecessary laboratory investigation and improper treatment in clinical practice. This condition causes both a psychological and physical burden on the patient and an economic burden.

Symptoms associated with lower cervical discopathies are better recognized and diagnosed more easily. Symptoms such as shoulder pain, restricted shoulder movement, weakness, pain radiating to the upper extremity, sensory deficits in the upper extremity, weakness in the upper extremity, back pain, dizziness, neck pain, and restricted neck movement are commonly encountered symptoms [8]. There is a limited number of studies about cervical disc disorder. Most studies have investigated clinical symptoms and findings, but to our knowledge, there is no study investigating the relationship between radiological findings and symptoms. Therefore, we aimed to evaluate clinical symptoms of both upper and lower degenerative cervical discopathies and investigate their relationship with radiological findings.

Materials and Methods

This study was designed as a cross-sectional observational study. The study was conducted on patients who presented to the neurology outpatient clinic of Afyonkarahisar Health Sciences University Hospital between June 1, 2021, and October 1, 2021.

Inclusion Criteria

Radiologically diagnosed with degenerative cervical discopathy, adult patients aged 18 years and older.

Exclusion Criteria

Presence of tumor or malformation in the head and neck region, pregnancy.

A total of 55 patients diagnosed with degenerative cervical disc disease were included in the study. The patients were examined by a specialist neurologist at the Afyonkarahisar Health Sciences University neurology clinic. The patients' symptoms were questioned, and their radiological findings were evaluated and recorded on a prepared form. The form included demographic information of the patients, symptoms (upper cervical region symptoms: cervicogenic headache, retroorbital pain, tinnitus, trigeminal neuralgia, dizziness, neck pain, restricted neck movement, neck paresthesia; lower cervical region symptoms: shoulder pain, restricted shoulder movement, shoulder weakness, pain radiating to the upper extremity, sensory deficit in the upper extremity, weakness in the upper extremity, back pain, dizziness, neck pain, restricted neck movement) [9]. Patients were categorized into upper cervical (above C4) and lower cervical (between C4 and C8) region symptoms [10].

Radiological imaging was performed using a 1.5-tesla imaging system (Siemens) and a standard phased-array spine coil. Cervical MRI was performed with the MRI device and interpreted by radiology specialist doctors. Imaging consisted of sagittal spin echo (SE) T1-weighted and sagittal fast spin echo (FSE) T2-weighted images, as well as oblique axial SE T1-weighted and T2-weighted gradient echo images. Sagittal imaging planes of the cervical spine were placed over a previous coronal scout image covering the entire spine, and oblique axial imaging planes directed along the plane of the intervertebral discs were captured to cover the planes derived from the spine, midline T2-weighted sagittal image, and all MRI findings were recorded.

Radiological classification of degenerative cervical discopathy was performed according to the classification system of Kellgren et al. [11] According to this classification: Absence of degeneration in the disc (grade 0), Minimal anterior osteophytosis (grade 1), Definite anterior osteophytosis; possible narrowing of the disc space; some sclerosis of vertebral plates (grade 2), Moderate narrowing of the disc space; definite sclerosis of vertebral plates; osteophytosis (grade 3), Severe narrowing of the disc space; sclerosis of vertebral plates; numerous large osteophytes (grade 4).

Ethical Aspect and Consent

Approval was obtained from the Ethics Committee of Afyonkarahisar Health Sciences University Faculty of Medicine (Date: 06.11.2020, Decision No: 2020/13, ethical code: 2011-KAEK-2) (Annex-1). Individuals included in the study were provided with information about the purpose, content, and benefits of the research according to the Helsinki Declaration, and their verbal consent was obtained.

Data Analysis

Statistical analyses were performed using SPSS 26.0 (IBM Corp. 2019. IBM SPSS Statistics for Windows, version 26.0. Armonk, NY: IBM Corp) software package. Categorical variables were presented as percentages and frequencies. The continuous variable age was expressed as mean±standard deviation. Chi-Square test, Fisher's Exact test, Fisher-Freeman-Halton test were used to compare the frequency of symptoms according to the level of cervical discopathy. All presented p-values were two-tailed, and values of $p<0.05$ were considered statistically significant.

Table 1. Upper Cervical Region

Symptoms	Cervical Level	
	C2-C3 (n, %)	C3-C4 (n, %)
Cervicogenic Headache	7 (12.7)	8 (14.5)
Retroorbital Pain	9 (16.3)	2 (3.6)
Tinnitus	2 (3.6)	
Trigeminal Neuralgia	6 (10.9)	2 (3.6)
Dizziness	1 (1.8)	3 (5.5)
Neck pain	14 (25.5)	13 (23.6)
Limitation of movement in the neck	10 (18.2)	14 (25.5)
Paresthesia in the neck	6 (10.9)	2 (3.6)

Results

A total of 55 patients were included in the study, 32 patients were female (58.2%) and 23 were male (41.8%). The mean age of the patients was found to be 56.3±12.9 years. Cervicogenic headache was observed in 15 (27.3%), retroorbital pain in 11 (20%), tinnitus in 2 (3.6%), trigeminal neuralgia in 8 (14.5%), dizziness in 8 (14.5%), neck pain in 49 (89.1%), restricted neck movement in 46 (83.6%), neck paresthesia in 8 (14.5%), shoulder pain in 20 (36.3%), restricted shoulder movement in 9 (16.3%), shoulder weakness in 7 (12.7%), pain radiating to the upper extremity in 23 (41.8%), sensory deficit in the upper extremity in 10 (18.2%), weakness in the upper extremity in 5 (9.1%), and back pain in 19 (34.5%) patients. The upper cervical region symptoms of the patients are illustrated in Table 1, and the lower cervical region symptoms are illustrated in Table 2.

The radiological findings of 55 patients are summarized in Table 3.

The relationship between cervical region and cervical symptoms is illustrated in Table 4.

Cervicogenic headaches were significantly higher in patients with Grade-2 changes at the C2-C3 vertebral level ($p<0.001$) and Grade-3 changes at the C3-C4 vertebral level ($p=0.001$) radiologically compared to other cervical levels.

Tinnitus was significantly higher in patients with Grade-2 changes at the C2-C3 vertebral level ($p<0.001$) compared to other cervical levels.

Trigeminal neuralgia was significantly higher in patients with Grade-2 changes at the C2-C3 vertebral level ($p=0.001$) and Grade-3 changes at the C3-C4 vertebral level ($p=0.021$) radiologically compared to other cervical levels.

Paresthesia on the neck was significantly higher in patients

Table 2. Lower Cervical Region Symptoms

Symptoms	Cervical Level			
	C4-5 (n, %)	C5-6 (n, %)	C6-7 (n, %)	C7-8 (n, %)
Shoulder Pain	10 (18.2)	3 (5.5)	7 (12.7)	
Limitation of movement in the neck	4 (7.3)	5 (9.1)		
Weakness in shoulder	4 (7.3)	3 (5.5)		
Pain in upper extremity	7 (12.7)	10 (18.2)	6 (10.9)	
Upper extremity sensory deficit	4 (7.3)	3 (5.5)	3 (5.5)	
Upper extremity weakness	2 (3.6)	1 (1.8)	1 (1.8)	1 (1.8)
Back pain			5 (9.1)	14 (25.5)
Dizziness	2 (3.6)	2 (3.6)		
Neck pain	7 (12.7)	7 (12.7)	5 (9.1)	3 (5.5)
Limitation of movement in the neck	7 (12.7)	3 (5.5)	6 (10.9)	6 (10.9)

Table 3. The radiological findings according to the Kellegren classification

	Grade 0 (n, %)	Grade 1 (n, %)	Grade 2 (n, %)	Grade 3 (n, %)	Grade 4 (n, %)
C2-C3	13 (23.6)	11 (20)	21 (38.2)	6 (10.9)	4 (7.3)
C3-C4	10 (18.2)	2 (3.6)	4 (7.2)	24 (43.6)	15 (27.2)
C4-C5	12 (21.8)	1 (1.8)	5 (9.1)	21 (38.1)	17 (30.9)
C5-C6	11 (20)	1 (1.8)	3 (5.5)	23 (41.8)	17 (30.9)
C6-C7	12 (21.8)	1 (1.8)	1 (1.8)	25 (45.5)	16 (29.1)

Table 4. The relationship between Cervical Symptoms and Cervical Regions

Symptoms	Cervical Level						
	Upper Cervical Region (n, %)	Lower Cervical Region (n, %)					p
	C2-C3	C3-C4	C4-5	C5-6	C6-7	C7-8	
Cervicogenic Headache	7 (12.7)	8 (14.5)					**<0.001**
Retroorbital Pain	9 (16.3)	2 (3.6)					**<0.001**
Tinnitus	2 (3.6)						**<0.001**
Trigeminal Neuralgia	6 (10.9)	2 (3.6)					**<0.001**
Paresthesia in the neck	6 (10.9)	2 (3.6)					**<0.001**
Shoulder Pain			10 (18.2)	3 (5.5)	7(12.7)		0.074
Limitation of movement in the neck			4 (7.3)	5 (9.1)			0.096
Weakness in shoulder			4 (7.3)	3 (5.5)			**<0.001**
Pain in upper extremity			7 (12.7)	10 (18.2)	6 (10.9)		0.185
Upper extremity sensory deficit			4 (7.3)	3 (5.5)	3 (5.5)		0.356
Upper extremity weakness			2 (3.6)	1 (1.8)	1 (1.8)	1 (1.8)	**0.006**
Back pain					5 (9.1)	14 (25.5)	**0.009**
Dizziness	1 (1.8)	3 (5.5)	2 (3.6)	2 (3.6)			0.270
Neck pain	14 (25.5)	13 (23.6)	7 (12.7)	7 (12.7)	5 (9.1)	3 (5.5)	**0.020**
Limitation of movement in the neck	10 (18.2)	14 (25.5)	7 (12.7)	3 (5.5)	6 (10.9)	6 (10.9)	0.240

Statistically significant values (p<0.05) are shown in bold.

with Grade-3 changes at the C2-C3 vertebral level (p<0.001) radiologically compared to other cervical levels.

Neck pain was statistically higher in patients with Grade-3 changes at the C4-5 and C5-6 levels (p=0.020, p=0.020 respectively).

Weakness in the shoulder and weakness in the upper extremity were significantly higher in patients with Grade-4 changes at the C4-5 vertebral level (p<0.001, p=0.006 respectively).

Weakness in the upper extremity was significantly higher in patients with Grade-3 changes at the C4-5 vertebral level and Grade-3 changes at other cervical vertebral levels compared to other patients (p=0.006).

Back pain was statistically higher in patients with Grade-4 changes at the C6-7 vertebral level (p=0.009) and Grade-3 changes at the C7-8 vertebral level (p=0.002) compared to other cervical levels.

Discussion

In this study, the symptoms in patients with degenerative cervical discopathy were investigated, and their relationship with radiological findings was evaluated. While symptoms such as cervicogenic headache, dizziness, retroorbital pain, tinnitus, and trigeminal neuralgia, which are beyond the usual, appeared in the upper cervical region, more recognized symptoms such as sensory and motor deficits, and radicular pain were recorded in the lower cervical region. The most remarkable finding in this study is the significantly high prevalence of trigeminal neuralgia. There was a relationship between clinical symptoms and cervical degeneration grade.

As far as considered, there are only two studies that have investigated the relationship between upper cervical discopathy and trigeminal neuralgia. In one study, 20 patients with trigeminal neuralgia were compared with a

control group of 20, and cervical discopathy was found to be significantly higher in patients with neuralgia [12].

In a very recent study, trigeminal neuralgia was found to be 12 times more prevalent in patients with degenerative changes in the cervical region compared to those without. However, the relationship between symptoms and radiological findings was not investigated in the same study [13].

Our study suggested that upper cervical region symptoms often manifest with milder radiological findings, while symptoms in the lower cervical region are more frequently associated with moderate to severe radiological findings.

Some studies have illustrated that upper cervical region discopathies can cause some less recognized symptoms such as vertigo, tinnitus, dizziness, facial pain, arm pain, and migraine headaches along with vertebrobasilar insufficiency [14].

Many studies have often investigated symptoms in the lower cervical region and found chronic neck pain, muscle spasms, crepitus, and/or paresthesia. Symptoms associated with the lower cervical region often include radicular pain, sensory-motor disturbances, and reflex changes. The sixth and seventh cervical nerve roots are commonly affected in the lower cervical region [10,14-18].

Cervical radiculopathy in physiopathology is associated with compression or inflammation of the cervical spinal nerve or nerve root. With aging, intervertebral discs degenerate, leading to a reduction in height and narrowing of the foramina [10,19]. Especially, chronic compression on the cervical spine causes a chronic reduction in intraparenchymal blood flow in the spinal cord, resulting in chronic ischemic changes, activating certain important biological events along with mechanical strain, and causing neuronal degeneration [3].

When symptoms are evaluated, cervicogenic headache is considered a characteristic of the upper cervical region. Although its etiopathogenesis is not fully understood, some theories have been proposed. Irritation or lesion of the upper cervical nerve roots has been recorded to play a role [20,21]. It is believed that the trigeminocervical nucleus and the upper cervical spinal dorsal horn play an important role in headaches [22]. The afferent pain fibers originating from the cortex, thalamus, hypothalamus, and upper cervical roots communicate with the trigeminal nerve's spinal nucleus. These signals are then directed via the facial nerve (CN VII) to facilitate parasympathetic dilation of the internal and external carotid arteries. The vasodilatory effect of the internal carotid, through a feedback mechanism with the trigeminal nerve's spinal nucleus, can trigger cervicogenic headaches [23].

The neurophysiological basis of cervicogenic headaches involves convergence between the afferent signals from the C1-C3 cervical nerves and the nociceptive afferents originating from the trigeminal nucleus. Structures innervated by the upper cervical nerves have shown the potential to cause cervicogenic headaches [24]. In a study involving 166 patients with cervical discopathy, it was found that 50 of them (30%) had cervicogenic headaches. The source of cervicogenic headaches in these patients was identified as the C2-C3 disc [25]. Our study found similar results when compared to the literature.

Vertigo, tinnitus, and hearing loss symptoms are generally attributed to the vestibular system. However, a more complex mechanism lies behind these symptoms. In the absence of peripheral or central vestibular pathology, the onset of dizziness signs and symptoms may originate from dysfunction in the neuromusculoskeletal structures of the cervical spine. Abnormal signals occurring in the joint receptors of the cervical spine are transmitted to the brainstem via ascending pathways. Cervicogenic dizziness (CGD) is defined as a "nonspecific sensation of directional change and imbalance in space caused by abnormal afferent activity in the neck." Although the pathophysiology of CGD is not fully understood, adverse changes in proprioceptors in the cervical spine can affect gaze stabilization, eye-head movement, and postural stability's sensorimotor control [26-28]. In a study involving 72 patients with benign paroxysmal vertigo attacks, they reported cervical discopathy in 3 patients (4.1%) [29]. Among these symptoms, tinnitus was observed in 2 patients (3.6%) participating in our study, while vertigo was observed in 8 patients (14.5%). The rate of vertigo in our study was found to be higher than in other studies. With tinnitus and dizziness, cervical discopathy should be considered as a differential diagnosis.

Cervical discopathy may play a role in the etiopathogenesis of trigeminal neuralgia (TN). Upper cervical discopathy can cause TN either by directly compressing the trigeminal spinal pathway or by inducing biochemical changes in the pathways emerging from the dorsal roots [30]. Other hypotheses that could lead to trigeminal neuralgia (TN) include the release of inflammatory cytokines by the affected cervical cord and the occurrence of ischemia or hypoxia due to vascular compression [13]. In our study, TN was observed in 8 patients. When evaluated with the results of our study, it indicates that the presence of cervical discopathy should be investigated before diagnosing idiopathic TN.

In a study conducted on lower cervical pathologies, the most common clinical symptoms were neck pain (82.9%), pain in the upper extremities (71.4%), sensory loss (62.9%), and decreased sensation (30%). These findings support our study [31,32].

There are some limitations of this study: Limited number of patients in terms of quantity. Absence of a control group and lack of neurological examination are significant limitations.

The advantage of the study: Comparing symptoms with radiological findings is the advantageous aspect of this study.

Conclusion

In conclusion, dizziness, retroorbital pain, and trigeminal neuralgia were found to be upper cervical region symptoms. Radicular pain, paresthesia, and weakness in the upper extremity were found to be lower cervical region symptoms, and these symptoms were found to be associated with the severity of radiological findings. More detailed and controlled studies with a larger number of patients in this regard will increase our knowledge and enable us to approach cervical discopathies more consciously.

Ethics Committee Approval: The study was approved by Afyonkarahisar Health Sciences University Faculty of Medicine Ethics Committee (No: 2011-KAEK-2, Date: 06/11/2020).

Peer-review: Externally peer-reviewed.

Use of AI for Writing Assistance: Not declared.

Authorship Contributions: Concept – A.M.; Design – S.B.A., E.A.H.; Supervision – G.Z.D.; Fundings – Z.Ö.; Materials – S.B.A.; Data collection &/or processing – A.M., E.A.H.; Analysis and/or interpretation – Ü.T.B.; Literature search – Z.Ö.; Writing – S.B.A.; Critical review – S.B.A.

Conflict of Interest: The authors declare that there is no conflict of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

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