RESEARCH ARTICLE

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Investigation of the Relationship Between Cervical Disc Herniations and Shoulder Complex Pathologies

ABSTRACT

Objective: The aim of our study was to investigate whether there is a relationship between shoulder complex pathologies and cervical disc herniations.

Materials and Methods: This study retrospectively included 524 patients with both dominant extremity shoulder and neck magnetic resonance examinations obtained from the information processing unit of Duzce University Faculty of Medicine between 01.08.2009-01.08.2023. The results were compared in Statistical Package for Social Sciences (SPSS).

Results: A total of 524 patients, 153 (29.2%) males and 371 (70.8%) females, with a mean age of 51.17±13.70 (range, 13-93) years, were included in the study. According to the statistical analysis of our study, 410 of the participants had supraspinatus pathology, 234 had infraspinatus pathology, 243 had subscapularis pathology and 11 had teres minor pathology. In addition, a statistically significant relationship was found between other shoulder pathologies and herniations at the C4-C5 and C5-C6 disc level ($p<0.05$).

Conclusions: In conclusion, even if there is a significant relationship between cervical disc herniations and shoulder pathologies, different methods should be developed for treatment algorithms and pain management. Evaluation of the cervical region should not be neglected in patient groups with shoulder pathologies.

Keywords: Supraspinatus, Disc Herniations, Shoulder Complex, Neck Pain.

Servikal Disk Herniasyonları ile Omuz Kompleks Kuşağı Patolojileri Arasında Ki İlişkinin İncelenmesi

ÖZET

Amaç: Çalışmamızın amacı, omuz kompleks kuşağı patolojileri ile servikal disk herniasyonları arasında bir ilişki olup olmadığını araştırmaktır.

Gereç ve Yöntem: Bu çalışma retrospektif olarak 01.08.2009-01.08.2023 tarihleri arasında X Üniversitesi Tıp Fakültesi bilgi işlem biriminden alınan hem dominant ekstremite omuz hem de boyun manyetik rezonans incelemesi bulunan 524 hasta dahil edilmiştir. Sonuçlar Statistical Package for Social Sciences (SPSS) te karşılaştırıldı.

Bulgular: Çalışmaya yaş ortalaması 51.17±13.70 (dağılım, 13-93) yıl olan 153 (%29.2) erkek ve 371 (%70.8) kadın olmak üzere toplam 524 hasta dahil edildi. Çalışmamızın istatistiksel analizine göre, katılımcıların 410'unda supraspinatus patolojisi, 234'ünde infraspinatus patolojisi, 243'ünde subskapularis patolojisi ve 11'inde teres minör patolojisi vardı. Ayrıca, diğer omuz patolojileri ile C4-C5 ve C5-C6 disk seviyesindeki herniasyonlar arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur ($p<0,05$).

Sonuç: Sonuç olarak, servikal disk herniasyonları ile omuz patolojileri arasında anlamlı bir ilişki olsa dahi tedavi algoritmaları ve ağrı yönetimi konusunda daha farklı yöntemler geliştirilmelidir. Omuz patolojileri olan hasta gruplarında servikal bölge değerlendirilmesi ihmal edilmemelidir.

Anahtar Kelimeler: Supraspinatus, Disk Herniasyonları, Omuz Kompleks Kuşağı, Servikal Ağrı.

INTRODUCTION

Neck pain is one of the oldest and most common problems that people face. Works related to this subject were found on papyrus in Egypt 4600 years ago. Hippocrates has various studies related with cervical injuries and cervical traction applications (1). Today, it takes its place after low back pain in the ranking of chronic pain. One out of every three people in the general population complains of neck pain that develops due to various causes at some time in their lives (2). The probability of radicular and spinal cord symptoms in people with neck pain remains below 3% (3). Shoulder pain is the third most common musculoskeletal system pathology (4). In recent years, the term shoulder complex has been used instead of shoulder pain because of difficulties in the management of shoulder pain and because of the complex anatomy of that region. In current treatment approaches, there are studies suggesting that the cause of pain is not always related to an injury and this has led to the development of different treatment strategies in clinics (bio-psycho-social treatment models)(5). The primary pathology of pain in the shoulder region may not always be rotator cuff lesions. In a study examining the causes of shoulder pain, pain radiating from the cervical region was found to be 5% (6). The innervation of the rotator cuff muscles, which have important functions in shoulder functions, is realised by the nerves formed by the C4 and C6 nerve roots. It has been emphasised that especially C5 radiculopathy mimics rotator cuff lesions, pain is usually localised in the shoulder, and there may be weakness in shoulder abduction and external rotation (7). Although there is no randomised or cohort study on this subject in the literature, the muscles in the shoulder girdle may be affected in cases where the cervical nerve roots are compressed. Therefore, conditions affecting the functionality of the neck, shoulder and upper extremity may occur.

The neck contains many structures sensitive to pain. Epidural venous structures, duramater, periosteum, vertebral bodies, nerve roots, dorsal root ganglion, muscular structures, facet joints, ligaments and intervertebral discs are pain sensitive structures (8, 9). The intervertebral disc is a non-sensitive structure and does not contain nucleus pulposus nerve tissue or nerve termination (55). Magnetic resonance imaging (MRI) classifications of disc herniations are still currently defined as 4 different stages (Bulging, Protruding, Sequestrated, Extruded) (10).

Rotator cuff muscles consist of supraspinatus, infraspinatus, subscapularis and teres minor muscles.

M.supraspinatus originates from the supraspinal aponeurosis in the fossa above the spina scapula. It passes over the joint capsule, under the acromion and coracoacromial arch and adheres to the upper part of the greater tubercle. It is innervated by the suprascapular nerve arising from the C4-C6 roots (11, 12). It makes the shoulder abduct. It makes maximum contraction at 30º elevation (13). It is the most important muscle of the rotator cuff and the most commonly injured muscle (14). M.infraspinatus starts from the fossa infraspinatus on the posterior aspect of the scapula and adheres to the postero-lateral aspect of the tuberculum majus of the humerus. It is innervated by N. suprascapularis (C5-C6). It is one of the most important external rotators of the shoulder. 60-90% of external rotation is provided by this muscle (15, 16). M. subscapularis starts from the subscapular fossa, passes in front of the joint and attaches to the tuberculum minus. It is stimulated by N.subscapularis (C5-C6). It causes internal rotation of the shoulder and functions as a humeral head depressor (17). M. teres minor starts from the outer edge of the scapula and attaches to the tuberculum majus. Its main function is to cause external rotation of the arm. It is innervated by N. Axillaris (C5-C6) (18).

Socio-economic problems caused by neck and shoulder pain are high and may impair quality of life (19). In this study, we aimed to retrospectively investigate whether there is a relationship between herniation types and rotator cuff lesions in the etiology of neck and shoulder pain, which we frequently encounter in the clinic, with cervical and shoulder magnetic resonance imaging findings.

MATERIAL AND METHODS

In this retrospective study, 524 patients with both dominant extremity shoulder and cervical magnetic resonance examination obtained from the data processing unit of Duzce University Faculty of Medicine between 01.08.2009-01.08.2023 were evaluated. Before starting the study, the approval of Duzce University non-interventional health research ethics committee was obtained. (Decision Number: 2023/162-16/10/2023)

MRI images of the patients on the system and the examinations reported by the specialist radiologist were reviewed. Additional triggers at the time of MRI were reviewed and if they should be excluded from the study, they were not evaluated. From the reports available on the system, the type of herniation (bulging, protruding, sequestered, extruded) at which spine level and other biomechanical pathologies were noted. After the report was analysed, it was further checked by a specialist neurosurgeon and the data was entered. A similar road map was followed in shoulder assessment. From the reports available on the system, it was noted which rotator cuff muscle of the patients had pathology. Other biomechanical pathologies of the patient's shoulder were noted. After the report review, the data were checked and entered by the specialist orthopedist and physiotherapist working on the musculoskeletal system. The inclusion criteria for the study were as follows: both cervical MRI and dominant extremity shoulder MRI were taken in the system, the patient

had not undergone shoulder or disc surgery before and did not have any other systemic disease.

The study was planned as a single group and subgroup comparisons were also made depending on demographic characteristics. Age, gender, dominant extremity, height-weight-body mass index and radiological findings were also analysed in detail.

Statistical Analysis: Data obtained were analyzed with IBM SPSS v.22 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) statistical package. Numerical data were expressed as mean and standard deviation, while frequency and percentage were used for categorical data. Categorical data were analyzed with the Pearson chi-square, Fisher's exact, or Fisher-Freeman-Halton test, as appropriate. A p-value of 0.05 was accepted as statistical significance level.

RESULTS

A total of 524 patients, 153 (29.2%) male and 371 (70.8%) female, with a mean age of 51.17±13.70 (range, 13-93) years were included in the study.

According to the statistical analysis of our study, 410 of the participants had supraspinatus pathology, 234 had infraspinatus pathology, 243 had subscapularis pathology, and 11 had teres minor pathology. In addition, a statistically significant relationship was found between other shoulder pathologies and herniations at the C4-C5 and C5-C6 disc level ($p<0.05$).

Statistically significant relationship was found between supraspinatus pathology and disc herniations at the C4-C5 level according to Table 1 ($p<0.05$).

Table 1. Relationship between Supraspinatus Pathologies and Cervical Disc Pathology Grades

	No Supraspinatus Pathology (n=114)	**Supraspinatus Pathology Available (n=410)**	**p**
C2-C3, n (%)	8 (7.0)	53 (12.9)	0.082
C3-C4, n (%)	44 (38.6)	195 (47.6)	0.089
C4-C5, n (%)	53 (46.5)	255 (62.2)	**0.003**
C5-C6, n (%)	82 (71.9)	298 (72.7)	0.873
C6-C7, n (%)	54 (47.4)	226 (55.1)	0.142
Cervical Lordosis, n (%)	70 (61.4)	234 (57.1)	0.407
Other Pathologies, n (%)	100 (87.7)	371 (90.5)	0.386

According to Table 2, a statistically significant relationship was found between infraspinatus pathology and disc herniations at all cervical levels ($p<0.05$).

Table 2. Relationship between Infraspinatus Pathologies and Cervical Disc Pathology Grades

	No Infraspinatus Pathology (n=290)	**Infraspinatus Pathology Available (n=234)**	**p**
C2-C3, n (%)	25 (8.6)	36 (15.4)	**0.016**
C3-C4, n (%)	120 (41.4)	119 (50.9)	**0.030**
C4-C5, n (%)	148 (51.0)	160 (68.4)	**<0.001**
C5-C6, n (%)	196 (67.6)	184 (78.6)	**0.005**
C6-C7, n (%)	136 (46.9)	144 (61.5)	**0.001**
Cervical Lordosis, n (%)	166 (57.2)	138 (59.0)	0.689
Other Pathologies, n (%)	254 (87.6)	217 (92.7)	0.052

In Table 3, a statistically significant relationship was found between subscapularis pathology and herniations at the C4-C5 and C5-C6 disc level ($p<0.05$).

Table 3. Relationship between Subskapularis Pathologies and Cervical Disc Pathology Grades

	No Subskapularis Pathology (n=281)	**Subskapularis Pathology Available (n=243)**	**p**
C2-C3, n (%)	28 (10.0)	33 (13.6)	0.198
C3-C4, n (%)	123 (43.8)	116 (47.7)	0.364
C4-C5, n (%)	150 (53.4)	158 (65.0)	**0.007**
C5-C6, n (%)	191 (68.0)	189 (77.8)	**0.012**
C6-C7, n (%)	147 (52.3)	133 (54.7)	0.580
Cervical Lordosis, n (%)	165 (58.7)	139 (57.2)	0.726
Other Pathologies, n (%)	252 (89.7)	219 (90.1)	0.867

Statistically significant inverse relationship was found between therux minor pathology and herniations at C4-C5 disc level according to Table 4 ($p<0.05$).

Table 4. Relationship between Teres Minör Pathologies and Cervical Disc Pathology Grades

	No Teres Minör Pathology (n=513)	Teres Minör Pathology Available (n=11)	p
C2-C3, n (%)	58 (11.3)	3 (27.3)	0.126
C3-C4, n (%)	234 (45.6)	5 (45.5)	0.992
C4-C5, n (%)	306 (59.6)	2 (18.2)	**0.010**
C5-C6, n (%)	373 (72.7)	7 (63.6)	0.735
C6-C7, n (%)	274 (53.4)	6 (54.5)	0.941
Cervical Lordosis, n (%)	298 (58.1)	6 (54.5)	0.999
Other Pathologies, n (%)	460 (89.7)	11 (100)	0.316

Statistically significant relationship was found between other shoulder pathologies and herniations at C4-C5 and C5-C6 disc level according to Table 5 ($p<0.05$).

Table 5. Relationship between other pathologies of the shoulder and pathologies at cervical disc levels

	Other Pathology None (n=20)	Other Pathology available (n=504)	p
C2-C3, n (%)	1 (5.0)	60 (11.9)	0.494
C3-C4, n (%)	9 (45.0)	230 (45.6)	0.995
C4-C5, n (%)	6 (30.0)	302 (59.9)	**0.008**
C5-C6, n (%)	9 (45.0)	371 (73.6)	**0.005**
C6-C7, n (%)	7 (35.0)	273 (54.2)	0.092
Cervical Lordosis, n (%)	14 (70.0)	290 (57.5)	0.268
Other Pathologies, n (%)	16 (80.0)	455 (90.3)	0.247

DISCUSSION

It is known that cervical region pathologies may be a source of pain radiating to the shoulder and arm, but there is no conclusive evidence for this. The exact causes of the concept of pain, as stated in current scientific studies, have not been clearly established (20-22). In this case, scientific studies have led to the development and discussion of new concepts on pain. Shoulder complex and neck pain conditions are two different conditions that can be confused with each other. These two pains can be labelled together or they can be independent of each other. Sembrano et al. found that 37.4% of patients presenting to the spine clinic had neck and shoulder pain, compared to 0.6% of patients presenting to the shoulder clinic (23). In the literature, there are studies suggesting that the cause of shoulder pain is related to cervical nerve root irritation.(24) Our study is consistent with the literature and cervical disc herniations and rotator cuff pathologies affect each other.

Some scientists think that radiculopathy, especially affecting the C5 and C6 roots, may cause atrophy and weakness in the shoulder rotator cuff muscles and deltoid muscle in addition to pain and sensory changes.In some studies, it has been reported that pain in the shoulder and upper extremity are findings observed in the initial stage of cervical radiculopathy (25). Some opinions in the literature have emphasised that involvement of the lower cervical nerve roots innervating the shoulder circumference may be effective in the development of painful shoulder even if there is no clear evidence of cervical radiculopathy(26). In our study, we aimed to evaluate the relationship between cervical pathologies and shoulder rotator cuff pathologies with MRI findings.

When the cervical and shoulder MRI examinations of the patients included in our study who complained of pain radiating from the neck to the shoulder were analysed; cervical disc herniation was present in 90.3% of the patients, and cervical pathologies such as spondylosis, disc herniation, and cervical narrow canal were present in all other patients. Among the patients with pathology in the supraspinatus muscle, which is most frequently injured, 62.2.5% had C4-C5 disc herniation, while 72.7% had C5-C6 disc herniation. We think that the C4-C7 interval, which is the most mobile part of the spine, may degenerate more quickly and the supraspinatus, which it innervates, may be affected more quickly. Although pathologies in the infraspinatus and subscapularis muscles are statistically significantly associated with cervical disc herniations, we think that the causes of pain are more related to the variation of spine and muscle biomechanics from person to person. Teres minor pathologies are a pathology that we do not encounter very often in clinics, and the most important reason for this is explained by a strong muscle architecture (27). When the literature is examined, cervical disc herniations are most commonly seen in C4-C5 and C5-C6 discs (7).

We named the problems that may be mechanical in the spine and shoulder complex region as other pathologies and found that these pathologies are also related to the most mobile disc levels, C4-C5 and C5-C6 regions. In this case, we think that both regions should be understood by detailed examination together with anamnesis in patients with shoulder and neck problems in clinics. Because even though shoulder complex pathologies and cervical disc herniations are related to each other, we think that a broader perspective should be developed in the cause of pain and a treatment algorithm should be created with bio-psycho-social models.

A review of the literature shows that the most commonly affected muscle is the supraspinatus, followed by the infraspinatus muscle. The subscapularis and teres minor muscles are affected less frequently (28, 29). When we analysed all of our patients, the finding of supraspinatus muscle tear more frequently was consistent with the literature.

The limitations of our study are that the patient evaluations were made retrospectively and the compliance of the patients with clinical tests could not be performed. The findings of this study indicate that the complaints of patients with cervical and shoulder complex region MRI cannot always be explained and support the need for bio-psycho-social modelled treatment algorithms in this regard.

In conclusion, it should be kept in mind that the primary pathology in patients with shoulder pain may not belong to rotator cuff pathology or the primary cause may not be disc herniation in a patient presenting with cervical pain. It should be kept in mind that shoulder pain and shoulder-related pathologies can also be seen in a patient with cervical pain and the treatment algorithm should be created with a broad perspective.

REFERENCES

1. Abi-Aad KR, Derian A. Cervical Traction. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2023, StatPearls Publishing LLC.; 2023.
2. Kazeminasab S, Nejadghaderi SA, Amiri P, Pourfathi H, Araj-Khodaei M, Sullman MJM, et al. Neck pain: global epidemiology, trends and risk factors. BMC Musculoskelet Disord. 2022;23(1):26.
3. Cohen SP. Epidemiology, diagnosis, and treatment of neck pain. Mayo Clin Proc. 2015;90(2):284-99.
4. Anwer S, Alghadir A. Incidence, Prevalence, and Risk Factors of Hemiplegic Shoulder Pain: A Systematic Review. Int J Environ Res Public Health. 2020;17(14).
5. Roe Y, Soberg HL, Bautz-Holter E, Ostensjo S. A systematic review of measures of shoulder pain and functioning using the International classification of functioning, disability and health (ICF). BMC Musculoskelet Disord. 2013;14:73.
6. Tunwattanapong P, Kongkasuwan R, Kuptniratsaikul V. The effectiveness of a neck and shoulder stretching exercise program among office workers with neck pain: a randomized controlled trial. Clin Rehabil. 2016;30(1):64-72.
7. Woods BI, Hilibrand AS. Cervical radiculopathy: epidemiology, etiology, diagnosis, and treatment. J Spinal Disord Tech. 2015;28(5):E251-9.
8. Raj PP. Intervertebral disc: anatomy-physiology-pathophysiology-treatment. Pain Pract. 2008;8(1):18-44.
9. Barreto TW, Svec JH. Chronic Neck Pain: Nonpharmacologic Treatment. Am Fam Physician. 2019;100(3):180-2.
10. Pfirrmann CW, Metzdorf A, Zanetti M, Hodler J, Boos N. Magnetic resonance classification of lumbar intervertebral disc degeneration. Spine (Phila Pa 1976). 2001;26(17):1873-8.
11. Huegel J, Williams AA, Soslowsky LJ. Rotator cuff biology and biomechanics: a review of normal and pathological conditions. Curr Rheumatol Rep. 2015;17(1):476.
12. Barcia AM, Makovicka JL, Spenciner DB, Chamberlain AM, Jacofsky MC, Gabriel SM, et al. Scapular motion in the presence of rotator cuff tears: a systematic review. J Shoulder Elbow Surg. 2021;30(7):1679-92.
13. Greenspoon JA, Petri M, Warth RJ, Millett PJ. Massive rotator cuff tears: pathomechanics, current treatment options, and clinical outcomes. J Shoulder Elbow Surg. 2015;24(9):1493-505.
14. Longo UG, Berton A, Papapietro N, Maffulli N, Denaro V. Biomechanics of the rotator cuff: European perspective. Med Sport Sci. 2012;57:10-7.
15. Bakhsh W, Nicandri G. Anatomy and Physical Examination of the Shoulder. Sports Med Arthrosc Rev. 2018;26(3):e10-e22.
16. Yang S, Kim TU, Kim DH, Chang MC. Understanding the physical examination of the shoulder: a narrative review. Ann Palliat Med. 2021;10(2):2293-303.
17. Culham E, Peat M. Functional anatomy of the shoulder complex. J Orthop Sports Phys Ther. 1993;18(1):342-50.
18. Yanny S, Toms AP. MR patterns of denervation around the shoulder. AJR Am J Roentgenol. 2010;195(2):W157-63.
19. Marks D, Comans T, Bisset L, Thomas M, Scuffham PA. Shoulder pain cost-of-illness in patients referred for public orthopaedic care in Australia. Aust Health Rev. 2019;43(5):540-8.
20. Onda A, Onozato K, Kimura M. Clinical features of neck and shoulder pain (Katakori) in Japanese hospital workers. Fukushima J Med Sci. 2022;68(2):79-87.

21. Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain. 2019;160(1):19-27.
22. Woolf CJ. What is this thing called pain? J Clin Invest. 2010;120(11):3742-4.
23. Sembrano JN, Yson SC, Kanu OC, Braman JP, Santos ER, Harrison AK, et al. Neck-shoulder crossover: how often do neck and shoulder pathology masquerade as each other? Am J Orthop (Belle Mead NJ). 2013;42(9):E76-80.
24. Corey DL, Comeau D. Cervical radiculopathy. Med Clin North Am. 2014;98(4):791-9, xii.
25. Takahashi R, Kajita Y, Harada Y, Iwahori Y, Deie M. Clinical results of shoulder manipulation under ultrasound-guided cervical nerve root block for frozen shoulder in patients with diabetes. J Orthop. 2020;21:297-301.
26. Childress MA, Becker BA. Nonoperative Management of Cervical Radiculopathy. Am Fam Physician. 2016;93(9):746-54.
27. Peterson SL, Rayan GM. Shoulder and upper arm muscle architecture. J Hand Surg Am. 2011;36(5):881-9.
28. Dang A, Davies M. Rotator Cuff Disease: Treatment Options and Considerations. Sports Med Arthrosc Rev. 2018;26(3):129-33.
29. Oh JH, Park MS, Rhee SM. Treatment Strategy for Irreparable Rotator Cuff Tears. Clin Orthop Surg. 2018;10(2):119-34.