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Original Article

Scapular dyskinesis and loss of cervical lordosis in myofascial pain syndrome and its effects on pain and posture disorders

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ABSTRACT

Objectives: This study aimed to evaluate scapular dyskinesia and loss of cervical lordosis in myofascial pain syndrome and its effects on pain and posture disorders.

Patients and methods: In this cross-sectional study, 101 individuals (74 females, 27 males; mean age: 44.3±8.8 years; range, 25 to 60 years) with chronic neck pain were recruited between January 2021 and February 2021. Demographic and clinical data of the patients were recorded. Visual Analog Scale (VAS), posture evaluation form, the scapular dyskinesia test, the lateral scapular shift test, and Cobb's methods for cervical angle measurements were used in the evaluation of the patients.

Results: In the study population, 52.25% of patients had loss of cervical lordosis, and 44.5% of patients had scapular dyskinesia. It was observed that the VAS activity score was significantly higher in individuals with loss of cervical lordosis, all VAS scores and pain duration were significantly higher in individuals with scapular dyskinesia ($p<0.05$). Shoulder elevation, rounded shoulder, forward head posture, and kyphosis were significantly higher in patients with scapular dyskinesia, while thoracic kyphosis was significantly higher in patients with both scapular dyskinesia and loss of cervical lordosis ($p<0.05$). The presence of trigger points was found to be significantly higher in patients with scapular dyskinesia and in patients with both scapular dyskinesia and loss of cervical lordosis ($p<0.05$).

Conclusion: In patients with chronic neck pain diagnosed with myofascial pain syndrome, the presence of loss of cervical lordosis and scapular dyskinesia have negative effects on pain and posture.

Keywords: Cervical lordosis, myofascial pain syndrome, neck pain, posture, scapular dyskinesia.

Neck pain is a common problem that occurs in any period of human life and affects 70% of society.[1] The etiology of neck pain includes pathologies affecting the intervertebral disc, facet joints, muscles, and ligaments.[2] Due to excessive movement of the cervical spine, long-term bad posture, sedentary lifestyle, and damage to the soft tissues in the neck region cervical stability gradually decreases, and this may cause loss of cervical lordosis.[3]

Myofascial pain syndrome is one of the most common causes of musculoskeletal pain, which is characterized by sensory, motor, and autonomic manifestations caused by localized trigger points in certain muscles or fascia.[4,5] Myofascial pain syndrome remains one of the most common sources of pain in chronic nonspecific neck pain.[4]

The scapula plays a major role in connecting the shoulder girdle and neck and ensuring the stability and movement of these regions. Scapular dyskinesia (SD) is one of the causes of chronic neck pain and is defined as impaired scapulohumeral rhythm during movement of the upper extremities or abnormal position of the

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scapula at rest.[6] In the pathogenesis of both chronic neck pain, myofascial pain syndrome, and SD, it was seen that long-term and excessive use of the muscles, decreased muscle strength, altered muscle movement patterns, changes in connective tissue physiology, loss of proprioception, decreased joint movements, aging, and poor posture due to the body midline changes play an important role.[4,6-8]

When looking at these data, it is seen that myofascial pain syndrome is both a cause and a result of postural disorders, abnormalities in cervical and thoracic angles, and SD. Although there are many studies in the literature examining scapular asymmetry in patients with shoulder problems, studies examining both the scapular and cervical alignment problems in patients with chronic neck pain are limited. Therefore, this study aimed to evaluate the association between the loss of cervical lordosis and SD and the effects of this association on pain and disorders posture in patients with chronic cervical myofascial neck pain.

PATIENTS AND METHODS

This is a cross-sectional study that was conducted in the Physical Medicine and Rehabilitation Clinic of the Erzurum Regional Training and Research Hospital between January 2021 and February 2021. All data were collected in the same facility by the same assessor. In this study, a total of 101 patients (74 females, 27 males; mean age: 44.3±8.8 years; range, 25 to 60 years) with chronic neck pain who were diagnosed with myofascial pain syndrome based on the diagnostic criteria of Simons et al.[9] were enrolled. Presence of neck or back pain due to other causes (e.g., disc herniation, brachial plexus lesion, degenerative diseases, psychological), previous surgery history in the painful area, detection of infection/inflammation, fibromyalgia syndrome, pregnancy, and malignancy history and abnormal detection of infection parameters were defined as exclusion criteria from the study.

The patients participating in the study were first evaluated in terms of the presence of loss of cervical lordosis and SD and the effects of this association on pain and posture disorders. Patients were divided into four groups according to the presence of loss of cervical lordosis and SD: the first group, the group without both loss of cervical lordosis and SD; the second group, the group with only loss of cervical lordosis; the third group, the group with only SD; the fourth group, the group with both loss of cervical lordosis and SD. Pain and posture disorders were compared between these groups.

First, the demographic characteristics of all participants were recorded in the case report form. The trigger point examination was performed by palpating the muscles in the neck and back region of all participants.[9] The pain level of the patients was evaluated with the Visual Analog Scale (VAS).[10]

Scapular dyskinesia test and lateral scapular shift test were used in the evaluation of dynamic/static scapular motions and the presence of SD.[11,12] In SD test, a 0.5 kg water bottle was placed in both hands while the patient was in a standing position. Starting with the arms at the sides in the resting position, the patient was asked to abduct the arms to 180° with the thumbs pointing up and then asked to lower them slowly. The test was repeated three times, and the scapulohumeral rhythm was observed.[11] The presence of dyskinesia and its type were classified according to the observed rhythm. Accordingly, three types of SD were determined: type 1, prominence of inferomedial border of the scapula; type 2, prominence of medial border of the scapula; type 3, prominence of superomedial border of the scapula.

The lateral scapular shift test was used to determine the position of the scapula in the abduction position of the arm in the coronal plane. In this test, the bilateral distance from the inferior angle of the scapula to the nearest vertebral spinous process is measured in three different positions. These positions are shoulder in the neutral position, shoulder at 45° coronal plane abduction with hands resting on hips, and the shoulder at 90° abduction with the arms in full internal rotation. A bilateral difference of 1.5 cm was considered the threshold for the presence of scapular asymmetry.[12]

In the evaluation of the posture disorders, the form prepared by Corbin et al.,[13] including the lateral and posterior observations, was used. For the evaluation of loss of cervical lordosis, lateral cervical radiographs were obtained in a neutral position from all patients. The cervical lordosis angle (CLA) was measured using the software in the PACS (picture archiving and communication system) as the angle between the C2 vertebra inferior plateau and C7 vertebra inferior plateau according to the Cobb method.[14] After the literature review, in our study, individuals with an CLA value of 0-10° were considered to have loss of cervical lordosis.[15]

Statistical analysis

The sample size of the study was calculated using the G*Power version 3.1.7 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). According to the study of Özünlü Pekyavaş et al.,[16] the sample size was calculated as 95 based on 5% type 1 error (α), 80% working power, and 0.28 effect size. Accordingly, 101 individuals with chronic neck pain were included in the study.

The statistical analysis was performed with IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistical methods were used for demographic data while evaluating the study data. The Shapiro-Wilk normality test and graphical methods were used to decide whether continuous variables showed normal distribution. Independent samples t-test and analysis of variance were used to compare independent parameters that did not conform to normal distribution between groups, the Mann-Whitney U test and the Kruskal-Wallis H test to compare independent parameters that did not conform to normal distribution between groups. The chi-square (Pearson's chi-square; Fisher exact test) test was used for the comparison of nominal data. The correlation between the data was analyzed with the Pearson correlation test. A *p*-value of <0.05 was considered statistically significant.

RESULTS

In the study population, 11 had neck pain on the right, eight had neck pain on the left, and 82 had pain on both sides. Evaluating the presence of trigger points in the study population, it was observed that the number of active trigger points in females, particularly the presence of active trigger points in the trapezius and rhomboideus muscles, was significantly higher (p=0.003, p=0.010, and

TABLE 1
Relationship between loss of cervical lordosis and demographic data

	Total (n=101)			Normal cervical lordosis (n=53)			Loss of cervical lordosis (n=48)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			44.3±8.8			44.5±8.1			44.1±9.7	0.844†
Sex										0.708*
Female	74	73.3		38	71.7		36	75		
Male	27	26.7		15	28.3		12	25		
Height (cm)			165.1±8.3			166.8±8.7			163.8±7.4	0.033‡
Weight (kg)			74.4±11.3			75.9±10.6			72.8±11.9	0.168†
Body mass index (kg/m²)										0.030*
Weak	0	0		0	0		0	0		
Normal	27	26.8		10	18.9		17	35.4		
Fat	56	55.4		36	67.9		20	41.7		
Over-weight	18	17.8		7	13.2		11	22.9		
Educational Status										0.093*
No Literacy	11	10.9		9	17		2	4.2		
Primary School	42	41.6		18	34		24	50		
Middle School - High School	36	35.6		18	34		18	37.5		
University	12	11.9		8	15.1		4	8.3		
Occupation										0.022*
Housewife	57	56.4		32	60.4		25	52.1		
Employee	19	18.8		12	22.6		7	14.6		
Desk worker	14	13.9		8	15.1		6	12.5		
Retired	11	10.9		1	1.9		10	20.8		

SD: Standard deviation; The *p*-value refers to the difference between the groups. * Chi-square test; † Mann-Whitney U test. ‡ Independent samples t-test.

p=0.049, respectively). When the relationship between neck pain and posture was evaluated, a statistically significant weak positive correlation was found between neck pain and shoulder protraction (p=0.046, rho=0.233). Also, it was observed that shoulder protraction was significantly higher in females (p=0.045). Visual Analog Scale activity, VAS rest, and VAS night scores were found to be significantly higher in individuals with forward head posture (FHP) (p=0.005, p=0.024, and p<0.001, respectively).

In the study population, 53 (52.25%) patients had loss of cervical lordosis, and 45 (44.5%) patients had SD. Scapular dyskinesia was observed on the right side in 29 (28.7%) of the study population and on the left side in 16 (15.8%). The most common types of SD were type 1 (n=19) and type 2 (n=19).

The relationship between loss of cervical lordosis and demographic data is given in Table 1. There is a statistically significant weak negative correlation between loss of cervical lordosis and height and body

TABLE 2
The relationship between loss of cervical lordosis and pain and posture disorders

	Total (n=101)			Normal cervical lordosis (n=53)			Loss of cervical lordosis (n=48)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Neck pain										0.733*
Right side	11	10.9		7	13.2		4	8.3		
Left side	8	7.9		4	7.6		4	8.3		
Bilateral	82	81.2		42	79.2		40	83.4		
VAS activity (mm)			71.6±15.9			68.4±13.8			45.4±31.4	0.036†
VAS rest (mm)			41.1±31.3			37.2±31.1			45.4±31.4	0.178†
VAS night (mm)			23.0±33.2			18.3±30.5			28.2±35.5	0.135†
Pain duration (months)			24.6±25.3			25.4±27.7			23.7±22.6	0.894†
Shoulder elevation										
No	72	71.3		38	71.7		34	70.8		0.807*
Yes, Right	19	18.8		9	17.0		10	20.8		
Yes, Left	10	9.9		6	11.3		4	8.3		
Rounded shoulders										
No	82	81.2		41	77.4		41	85.4		0.301*
Yes	19	18.8		12	22.6		7	14.6		
Forward head posture										
No	83	82.1		42	79.2		41	85.4		0.418*
Yes	18	17.8		11	20.8		7	14.6		
Thoracic kyphosis										
No	83	82.1		44	83		39	81.2		0.817*
Yes	18	17.8		9	17		9	18.8		
Shoulder protraction										
No	80	79.2		44	83		36	75		0.321*
Yes	21	20.8		9	17		12	25		
Lateral head tilt										
No	92	91.2		46	86.8		46	95.8		0.180*
Yes, Right	6	5.9		4	7.5		2	4.2		
Yes, Left	3	2.9		3	5.7		0	0		

SD: Standard deviation; VAS: Visual Analog Scale; The *p*-value refers to the difference between the groups. * Chi-square test. † Mann-Whitney U test.

TABLE 3
The relationship between scapular dyskinesis and demographic data

	Total (n=101)			No scapular dyskinesia (n=56)			Scapular dyskinesia on the right (n=29)			Scapular dyskinesia on the left (n=16)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			44.3±8.8			45.4±9.1			42.6±7.8			43.4±9.6	0.327†
Sex													0.175*
Female	74	73.3		38	67.9		25	86.2		11	68.8		
Male	27	26.7		18	37.1		4	13.8		5	31.2		
Height (cm)			165.1±8.3			165.6±9.1			163.8±6.7			165.9±7.9	0.772#
Weight (kg)			74.4±11.3			74.6±11.4			73.9±12.3			74.4±9.5	0.960†
Body mass index (kg/m²)													0.489*
Weak	0	0		0	0		0	0		0	0		
Normal	27	26.8		15	26.8		9	31		3	18.8		
Fat	56	55.4		3	53.6		14	48.3		12	75		
Over-weight	18	17.8		11	19.6		6	20.7		1	6.2		
Educational status													0.263*
No literacy	11	10.9		3	5.4		6	20.7		2	12.5		
Primary School	42	41.6		21	37.5		13	44.8		8	50		
Middle School - High School	36	35.6		23	41.1		8	27.6		5	31.2		
University	12	11.9		9	16.1		2	6.9		1	6.2		
Occupation													0.144*
Housewife	57	56.4		27	48.2		21	72.4		9	56.2		
Employee	19	18.8		10	17.2		5	17.2		4	25		
Desk worker	14	13.9		9	16.1		2	6.9		3	18		
Retired	11	10.9		10	17.9		1	3.4		0	0		

SD: Standard deviation; The *p*-value refers to the difference between the groups; * Chi-square test; † Kruskal Wallis H test; # ANOVA.

TABLE 4
The relationship between scapular dyskinesis and pain and posture disorders

	Total (n=101)			No scapular dyskinesia (n=56)			Scapular dyskinesia on the right (n=29)			Scapular dyskinesia on the left (n=16)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Neck pain													
Right side	11	10.9		7	12.5		2	6.9		2	12.5		0.600*
Left side	8	7.9		6	10.7		2	6.9		0	0		
Bilateral	82	81.2		43	76.8		25	86.2		14	87.5		
VAS activity (mm)			71.6±15.9			67.4±15.9			78.7±14.1			73.6±14.8	<0.01†
VAS rest (mm)			41.1±31.3			29.1±28.3			65.8±24.0			38.5±28.5	<0.001†
VAS night (mm)			23.0±33.2			11.9±25.1			44.7±37.4			23.0±32.3	<0.001†
Pain duration (months)			24.6±25.3			20.9±21.3			34.4±33.2			19.6±17.0	0.098†
Shoulder elevation													
No	72	71.3		47	83.9		17	58.6		8	50		0.036*
Yes, Right	19	18.8		6	10.7		8	27.6		5	31.3		
Yes, Left	10	9.9		3	5.4		4	13.8		3	18.7		
Rounded shoulders													
No	82	81.2		49	87.5	49	19	65.5		14	87.5		0.038*
Yes	19	18.8		7	12.5	7	10	34.5		2	12.5		
Forward head posture													
No	83	82.1		55	98.2		20	69		8	50		<0.001*
Yes	18	17.8		1	1.8		9	31		8	50		
Thoracic kyphosis													
No	83	82.1		50	89.3		23	79.3		10	62.5		0.042*
Yes	18	17.8		6	10.7		6	20.7		6	37.5		
Shoulder protraction													
No	80	79.2		46	82.1		22	75.9		12	75		0.718*
Yes	21	20.8		10	17.9		7	24.1		4	25		
Lateral head tilt													
No	92	91.2		51	91.1		26	89.7		15	93.7		0.733*
Yes, Right	6	5.9		4	7.1		2	6.9		0	0		
Yes, Left	3	2.9		1	1.8		1	3.4		1	6.3		

SD: Standard deviation; VAS: Visual Analog Scale; The *p*-value refers to the difference between the groups; * Chi-square test; † Kruskal Wallis H test.

TABLE 5
Relationship between groups and demographic data

	Group 1 (n=27)			Group 2 (n=31)			Group 3 (n=27)			Group 4 (n=16)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			45.1±9.4			44.9±9.3			44.3±7.1			41.7±9.9	0.627†
Sex													0.517*
Female	17	63		23	74.2		21	77.8		13	81.3		
Male	10	37		8	25.8		6	22.2		3	18.7		
Height (cm)			169.0±9.7			162.3±7.0			164.9±7.3			164.1±7.5	0.034#
Weight (kg)			77.3±11.0			72.0±11.1			74.6±10.1			73.8±13.8	0.352†
Body mass index (kg/m²)													0.201*
Weak	0	0		0	0		0	0		0	0		
Normal	5	18.5		11	35.5		5	18.5		6	37.5		
Fat	19	70.4		12	38.7		18	66.7		7	43.8		
Over-weight	3	11.1		8	25.8		4	14.8		3	18.7		
Educational status													0.041*
No Literacy	2	7.5		1	3.2		7	26		1	6.3		
Primary School	10	37		12	38.7		9	33.3		11	68.7		
Middle School - High School	9	33.3		14	45.1		9	33.3		4	25		
University	6	22.2		4	13		2	7.4		0	0		
Occupation													0.011*
Housewife	13	48.2		15	48.4		19	70.4		10	62.4		
Employee	8	29.6		2	6.5		5	18.5		4	25		
Desk worker	5	18.5		5	16.1		3	11.1		1	6.3		
Retired	1	3.7		9	29		0	0		1	6.3		

SD: Standard deviation; The *p*-value refers to the difference between the groups; Group 1: The group without both loss of cervical lordosis and SD; Group 2: The group with only loss of cervical lordosis; Group 3: The group with only SD; Group 4: The group with both loss of cervical lordosis and SD; * Chi-square test; † Kruskal Wallis H test; # Analysis of variance.

TABLE 6
The relationship between groups and pain and posture disorders

	Group 1 (n=27)			Group 2 (n=31)			Group 3 (n=27)			Group 4 (n=16)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Neck pain													0.690*
Right side	5	18.5		3	9.7		2	7.4		1	6.3		
Left side	3	11.1		3	9.7		1	3.7		1	6.3		
Bilateral	19	70.4		25	80.6		24	88.9		14	87.4		
VAS activity (mm)			63.3±14.2			72.6±17.2			73.7±11.0			79.8±19.1	<0.01†
VAS rest (mm)			25.0±27.1			36.2±31.0			49.7±29.7			63.4±25.3	<0.001†
VAS night (mm)			6.3±18.2			20.5±31.5			31.7±35.3			41.7±40.1	<0.01†
Pain duration (months)			18.7±18.0			22.8±23.6			31.6±33.7			26.1±21.6	0.340†
Shoulder elevation													0.241*
No	23	85.2		24	77.4		16	59.3		9	56.3		
Yes, Right	3	11.1		5	16.1		6	22.2		5	31.2		
Yes, Left	1	3.7		2	6.5		5	18.5		2	12.5		
Rounded shoulders													0.382*
No	23	85.2		27	87.1		19	70.4		13	81.3		
Yes	4	14.8		4	12.9		8	29.6		3	18.7		
Forward head posture													<0.001*
No	26	96.3		31	100		17	63		9	56.3		
Yes	1	3.7		0	0		10	37		7	43.7		
Thoracic kyphosis													<0.01*
No	22	81.5		30	96.8		23	85.2		8	50		
Yes	5	18.5		1	3.2		4	14.8		8	50		
Shoulder protraction													0.529*
No	24	88.9		23	74.2		21	77.8		12	75		
Yes	3	11.1		8	25.8		6	22.2		4	25		
Lateral head tilt													0.587*
No	24	88.9		29	93.5		23	85.2		16	100		
Yes, Right	2	7.4		2	6.5		2	7.4		0	0		
Yes, Left	1	3.7		0	0		2	7.4		0	0		

SD: Standard deviation; VAS: Visual Analog Scale; The *p*-value refers to the difference between the groups; Group 1: The group without both loss of cervical lordosis and SD; Group 2: The group with only loss of cervical lordosis; Group 3: The group with only SD; Group 4: The group with both loss of cervical lordosis and SD; * Chi-square test; † Kruskal Wallis H test.

mass index (rho=-0.214 and rho=-0.052, respectively). There is a statistically significant weak positive correlation between loss of cervical lordosis and occupation (rho=0.208). Loss of cervical lordosis was found to be significantly higher in retired individuals.

The relationship between loss of cervical lordosis and pain is given in Table 2. A statistically significant weak positive correlation was found between VAS activity score and loss of cervical lordosis (rho=0.209). No statistically significant relationship was found between loss of cervical lordosis and the number and presence of trigger points (p>0.05).

The relationship between loss of cervical lordosis and posture is given in Table 2. No significant relationship was found between posture disorders and loss of cervical lordosis.

The relationship between SD and demographic data is given in Table 3. No statistically significant relationship was found between the presence of SD and demographic data. When SD types were compared with demographic data, a statistically significant weak positive correlation was found between SD types and age (p=0.037, rho=0.130).

The relationship between SD and pain is given in Table 4. It was observed that VAS activity, VAS rest, and VAS night scores were significantly higher in individuals with SD. When the relationship between SD and trigger points was evaluated, the number of active trigger points was found to be statistically significantly higher in the group with SD (p=0.001). In addition, the presence of trigger points in the trapezius, rhomboideus, levator scapula, and serratus anterior was significantly higher in patients with SD (p=0.031, p=0.003, p=0.007, p=0.007, and p=0.007, respectively).

The relationship between SD and posture disorders is given in Table 4. Shoulder elevation, rounded shoulder, FHP, and kyphosis were significantly higher in patients with SD. In addition, a statistically significant weak and moderate negative correlation was found between SD type and shoulder elevation and FHP (p<0.001; rho=-0.253 and rho=-0.419, respectively).

The relationship between groups and demographic data are given in Table 5. A statistically significant weak negative correlation was found between the groups and height, education level, and occupation (rho=-0.166, rho=-0.257, and rho=-0.215, respectively). Additionally, loss of cervical lordosis was significantly higher in retirees and SD was significantly higher in housewives.

The relationship between groups and pain is given in Table 6. Visual Analog Scale activity, VAS night, and VAS rest scores were significantly higher in the fourth group. When evaluating the relationship between groups and the trigger points, a statistically significant strong positive correlation was found between groups and active trigger points (p=0.002, rho=0.805). The presence of active trigger points in the rhomboideus, levator scapula, serratus anterior, and latissimus dorsi muscles was significantly higher in the fourth group (p=0.008, p=0.028, p=0.044, and p=0.035, respectively).

The relationship between groups and posture disorders is given in Table 6. It was observed that the FHP in the third and fourth groups and the thoracic kyphosis in the fourth group were significantly higher. When the frequency of SD types among the groups was examined, it was found that type 1 was significantly more common in the third group, whereas type 1 and type 2 were more common in the fourth group (p<0.001).

DISCUSSION

In the study population, 52.25% of patients had loss of cervical lordosis and 44.5% of patients had SD. It was observed that the VAS activity score was significantly higher in individuals with loss of cervical lordosis, all VAS scores and pain duration were significantly higher in individuals with SD (p<0.05). The number of active trigger points was found to be statistically significantly higher in the group with SD. In addition, the presence of trigger points in the trapezius, rhomboideus, levator scapula, and serratus anterior was significantly higher in patients with SD. Shoulder elevation, rounded shoulder, FHP, and kyphosis were significantly higher in patients with SD. Active trigger points in the rhomboideus, levator scapula, serratus anterior, and latissimus dorsi muscles and all VAS scores were significantly higher in the fourth group. It was observed that the FHP in the third and fourth groups, and thoracic kyphosis in the fourth group were significantly higher.

Cervical lordosis is the first physiological curvature of the human spine, which plays an important role in maintaining the stability of the spine and maintaining normal spinal biomechanics.[17] In recent years, there has been an increase in the incidence of cervical curvature abnormalities due to an increase in a sedentary lifestyle, sitting for hours at a computer, and prolonged poor posture. Various studies have indicated that the loss of the physiological cervical lordosis could be a possible cause of chronic neck pain, due to muscular imbalance or structural overload of the anterior parts of the spine.[3,18]

In the literature, it is stated that the incidence of cervical segmental kyphosis in subjects with neck pain is 35 to 39%.[19,20] In our study, the incidence of loss of cervical lordosis was found to be 52.25% in individuals with neck pain.

A recent study showed that, in individuals around 40 years of age and with no kyphotic deformity, the mean cervical lordotic curve was lowest in a group with chronic neck pain and greatest in normal controls.[21] Furthermore, some studies have highlighted the negative consequences of kyphotic cervical configurations after surgery, in terms of axial pain and accelerated adjacent segment degeneration.[21,22] In our study, it was observed that there was a positive correlation between loss of cervical lordosis, neck pain, and VAS activity score. We think that this situation occurs secondary to the tension or weakness of the cervical region muscles that cause loss of cervical lordosis.

The scapula plays a major role in connecting the shoulder girdle and neck and maintaining the stability and movement of these regions.[12] Scapular dyskinesia is a condition that refers to an impaired scapulohumeral rhythm by the movement of the upper extremities or the abnormal position of the scapula at rest.[11,12] In literature, there are different studies that reveal a positive association between neck pain and biomechanical changes in cervical and scapular structures.[23-26]

In a study evaluating scapular position in computer professionals with and without neck pain, it has been reported that the changes in scapular position in individuals with neck pain are associated with pain.[24] Szeto et al.[25] compared office workers with neck pain and office workers without neck pain and stated that scapular protraction, particularly inward and outward rotation, was more common in patients with neck pain. Dahiya and Ravindra[24] reported that there was a significant difference in the upward rotation of the scapula at rest and shoulder abduction in patients with neck pain. In our study, similar to the literature, a positive correlation was found between SD and neck pain and all VAS scores. It could be said that this situation occurs secondary to the tightness or weakness of the axioscapular muscles that cause SD.

One of the most important causes of neck pain is muscle pain that develops due to posture disorder. In chronic neck pain, posture disorders occur secondary to anatomical midline changes due to the decrease in joint position sense and imbalance in the axioscapular muscles.[7,8,27]

Forward head posture is one of the most common posture changes in patients with neck pain.[28] This poor posture causes flattened neck and loss of cervical lordosis increases.[29-31] This condition can cause stretching and shortening of neck and shoulder musculature, changes in scapular kinetics and kinematics, and musculoskeletal pain can be seen.[31-33] In a study comparing the cervical angle of neck pain patients with age-matched pain-free subjects, it was stated that patients who complained of spontaneous neck pain have poorer posture than healthy individuals, and also the degree of FHP tends to be increased with age due to a reduced range of motion in the cervical region.[28] In our study, there was no significant relationship between age and loss of cervical lordosis and FHP, but it was observed that loss of cervical lordosis was significantly higher in retired individuals. Studies evaluating the relationship between neck pain and CLA, it is stated that cervical lordosis decreases with increasing FHP in patients.[32,34] Watson and Trott[35] reported a significantly lesser craniovertebral angle value in the tension-type headache group compared to the group without headache. They also stated that there was a positive correlation between craniovertebral angle reduction and FHP and loss of cervical lordosis.[35] In our study, a positive correlation was found between loss of cervical lordosis and FHP, but no statistically significant relationship was found. However, the presence of FHP was found to be statistically significantly higher in patients with SD and in patients with both SD and loss of cervical lordosis. This situation shows that the presence of SD is associated with FHP and the presence of SD accompanying loss of cervical lordosis increases the relationship between FHP and loss of cervical lordosis. Based on the assumption that a problem in a joint region can affect at least one lower and one upper segment, as explained in the kinetic chain theory, we think that it is necessary to evaluate the cervical, shoulder, and scapular regions when evaluating chronic neck pain.

Other common postural disorders in patients with neck pain are shoulder protraction, rounded shoulder, and thoracic kyphosis, which cause an imbalance in the axioscapular muscles secondary to changes in scapular and glenohumeral kinematics.[36,39] Additionally, in a study, a significant relationship was reported between FHP and thoracic kyphosis.[39] Christie et al.[40] evaluated head position, shoulder position (a relative measure of protraction and retraction), shoulder elevation, and thoracic kyphosis of subjects with low back pain and without low back pain. They reported thoracic kyphosis, increased FHP, and abnormal shoulder position in the group with low back pain. In our study, while FHP, shoulder elevation, rounded shoulder, and thoracic kyphosis were found to be significantly higher in patients with SD, thoracic kyphosis was found to be significantly higher in patients with both loss of cervical lordosis and SD. Similar to the literature, it was concluded in our study that the tightness and weakness of the axioscapular muscles are associated with both posture disorders and cervical and scapular region alignment problems.

Limitations of this study was conducted in a single center, and other spinal sagittal alignment disorders were not evaluated. However, the adequacy of the number of patients obtained by power analysis, participants being evaluated by the same researcher under equal conditions, the use of objective data for evaluation can be specified as the strengths of the study.

In conclusion, this study found that pain and posture-related parameters were more negatively affected in patients with loss of cervical lordosis accompanied by SD. This situation suggests that scapular movements should also be evaluated in patients with neck pain and loss of cervical lordosis, and scapular movement disorders should be taken into account when planning the treatment. Therefore, we think it would be beneficial to reduce drug use, neck pain, and disability to include range of motion exercises, proprioceptive exercises, scapular stabilization exercises, and posture exercises in the physical therapy program for patients with chronic neck pain.

Ethics Committee Approval: We would like to thank Doctors of Physical Medicine and Rehabilitation Clinic of Erzurum Regional Training and Research Hospital for their support in referring the study patients to us.

Ethics Committee Approval: The study protocol was approved by the Erzurum Regional Training and Research Hospital Non-interventional Clinical Research Ethics Committee (date: 18.01.2021, no: KAEK2021/02-25). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Concept or design of the study, drafting of the manuscript: H.T., G.S.; Acquisition of data: G.S.; Analysis or interpretation of data: H.T.; Critical revision for important intellectual content: H.T.

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