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Clinical Pilates Impact on Pain, Joint Mobility, and Scapular Dyskinesia in Chronic Neck and Shoulder Pain Patients

Tansu ŞİMŞEK [1]
[1]İstanbul Okan University, Graduate Education Institute, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye

Emine ATICI [2]
[2]İstanbul Okan University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye

Özgür SÜRENKÖK [2]
[2]İstanbul Okan University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye

ABSTRACT

Objective: The present study aimed to investigate the effects of clinical Pilates on pain intensity, joint range of motion (ROM), and scapular dyskinesia in individuals with chronic neck and shoulder pain.

Method: A total of 28 participants with chronic neck and shoulder pain were enrolled in the study. The intervention consisted of clinical Pilates exercises conducted twice weekly over a period of eight weeks under the supervision of a physiotherapist. Pain intensity was measured using the Visual Analog Scale (VAS). Cervical and glenohumeral joint range of motion were assessed with a standard goniometer. Scapular dyskinesia was evaluated using the Lateral Scapular Slide Test (LSST).

Results: Following the intervention, a statistically significant reduction in pain intensity was observed (p<.05). Cervical ROM improved significantly in all directions (p<.05). Significant gains in shoulder ROM were also noted, except for internal rotation and adduction, which did not reach statistical significance (p>.05). Additionally, there was a significant improvement in scapular positioning as indicated by a reduction in scapular dyskinesia scores on the LSST (p<.05).

Conclusion: The results suggest that clinical Pilates may be an effective therapeutic approach for reducing pain, enhancing joint mobility, and improving scapular stability in individuals suffering from chronic neck and shoulder pain. These findings support the incorporation of clinical Pilates into rehabilitation programs targeting neuromusculoskeletal dysfunctions of the cervical and shoulder regions.

Keywords: Chronic pain, dyskinesia, pilates exercises, scapular stability.

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Corresponding author: Emine ATICI
E-mail: emimert@gmail.com

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Introduction

Chronic neck and shoulder pain is a major global health concern, affecting approximately 20% of the adult population and ranking as the fourth leading cause of disability (Şahan et al., 2025). The coexistence of cervical spine dysfunction, scapular dyskinesis, and postural a.bnormalities necessitates comprehensive and integrative therapeutic approaches. Pilates, a mind-body exercise method that emphasizes core stability, postural alignment, and controlled movement patterns, has recently emerged as a promising intervention for musculoskeletal pain conditions (Lazoura et al., 2024; Sahiner Picak & Yesilyaprak, 2023).

The effectiveness of Pilates in reducing pain intensity has been consistently demonstrated in the literature. Şahiner Pıçak and Yeşilyaprak (2023)(Sahiner Picak & Yesilyaprak, 2023) reported statistically significant improvements in VAS scores following a six-week clinical Pilates program. Similarly, de Araujo et al. (Goulart et al., 2016) confirmed the effectiveness of Pilates in patients with chronic mechanical neck pain, showing improvements in pain, function, and quality of life, along with reduced use of analgesics.

Clinical Pilates has also been shown to enhance joint mobility. Sahiner Picak and Yesilyaprak (2023) demonstrated significant improvements in cervical range of motion in all directions of movement in the intervention group compared to controls. Furthermore, cross-sectional studies have indicated superior postural alignment among Pilates practitioners compared to inactive individuals. For example, Goulart et al. (2016) reported better horizontal acromion alignment, reduced scapular asymmetry, and improved vertical body alignment in children practicing Pilates.

Although direct evidence on the effects of Pilates for scapular dyskinesis is limited, related research highlights the importance of scapular stabilization in the management of neck pain. Studies investigating scapular stabilization exercises have demonstrated significant improvements in functional outcomes among patients with chronic neck pain (Javdaneh et al., 2022).

The present study aims to address this gap by investigating the effects of clinical Pilates on pain, joint mobility, and scapular dyskinesis in individuals with neck and shoulder pain. Through a comprehensive evaluation, we seek to clarify the therapeutic role of clinical Pilates in this patient population and provide valuable insights for clinicians and researchers. By bridging conventional physiotherapy with alternative approaches such as Pilates, this study aspires to contribute to the development of more comprehensive and effective management strategies for individuals suffering from neck and shoulder pain.

Methods

Type of the Study

This is a quasi-experimental study designed to determine the effect of clinical Pilates on scapular dyskinesis and normal joint range of motion in patients with chronic shoulder and neck pain.

Place and Time of the Study

The study was conducted at Istanbul Fizikom Physical Therapy Rehabilitation Center.

Participants

A total of 28 patients aged between 18 and 65 years with chronic neck and shoulder pain participated in the study.

Inclusion criteria:

- Chronic neck and/or shoulder pain lasting at least three months
- Diagnosed pathology in neck and/or shoulder region
- No pilates experience in the last three months
- Adequate joint mobility (abduction 45–90°, full internal rotation in neutral)

Exclusion criteria:

- Pain duration <1 month
- Neuromuscular dysfunction
- History of surgery in the neck/shoulder region
- BMI >39 kg/m²

Sample size was determined using G*Power 3.1, based on a previous study (Özünlü et al., 2014), with $\alpha = 0.05$ and $d = 0.17$, yielding a required sample of 28.

Measures

Demographic data, including participants' age, gender, and educational background, were recorded at baseline. Pain intensity, joint range of motion (ROM), and scapular dyskinesis were assessed using standardized clinical tools prior to and following the intervention.

Pain Assessment: Pain severity was evaluated using the Visual Analog Scale (VAS), a 100 mm horizontal line anchored by descriptors of "no pain" (score: 0) and "worst possible pain" (score: 10). Participants were instructed to mark their current level of pain along the line, with the distance from the "no pain" anchor point recorded in millimeters as the pain score (Rodrigues et al., 2014).

Cervical Range of Motion: Cervical spine mobility, including flexion, extension, lateral flexion (right and left), and rotation (right and left), was measured using a standard goniometer following the methodology described by Lea and Gerhardt (1995).

Glenohumeral Joint Range of Motion: Shoulder joint mobility was assessed using a goniometer according to therapeutic movement protocols outlined by Hayes et al. (2001). The measured movements included shoulder flexion, extension, abduction, adduction, internal rotation, and external rotation.

Scapular Dyskinesis Assessment – Lateral Scapular Slide Test (LSST): Scapular positioning and symmetry were evaluated using the LSST. Measurements were taken bilaterally in three arm positions: (1) arms relaxed at the sides (neutral), (2) hands placed on the iliac crests with thumbs directed posteriorly, and (3) shoulders abducted to 90 degrees with maximal internal rotation. In each position, the linear distance between the inferior angle of the scapula and the corresponding spinous process of the thoracic vertebra was measured in the horizontal plane. According to Kibler's original criteria, a bilateral asymmetry exceeding 1.0 cm was considered indicative of scapular dyskinesis, though subsequent revisions raised this threshold to 1.5 cm (Curtis & Roush, 2006).

Intervention Protocol: Participants engaged in a supervised clinical Pilates exercise program consisting of 50-minute sessions conducted twice per week over a period of eight weeks.

Data Collection

Chronic neck and shoulder pain patients received an 8-week clinical pilates program, comprising 50-minute sessions twice a week. The treatment program was adapted from previously published protocols, with some minor modifications made by our research team. The program progressively increased exercise difficulty and repetitions while focusing on five fundamental elements: control, breath, fluidity, precision, and centering. Patients were guided to maintain postural alignment throughout the exercises with verbal and tactile cues.

Treatment Program Breakdown:

1. Week: Swan dive (first level), chest expansion preparation (first level), chest expansion, silent waiter, pectoral stretching exercises (12 repetitions each).

2. Week: Swan dive (first level), chest expansion preparation (second level), chest expansion, cleopatra, pectoral stretching exercises (14 repetitions each).

3. Week: Swan dive (first level), chest expansion preparation (second level), chest expansion, cleopatra, pectoral stretching exercises (12 repetitions, 2 sets each).

4. Week: Swimming (second level), swan dive (second level), chest expansion, twist, cleopatra (12 repetitions, 2 sets each; reduced rest intervals aimed at increasing endurance).

5. Week: Swimming (second level), swan dive (third level), chest expansion, twist, cleopatra (12 repetitions, 2 sets each; reduced rest intervals aimed at increasing endurance).

6. Week: Swimming (third level), swan dive (third level), chest expansion, twist, cleopatra (12 repetitions, 2 sets each; reduced rest intervals aimed at increasing endurance).

7. Week: Swimming (third level), swan dive (third level), chest expansion, twist, cleopatra (14 repetitions, 2 sets each; reduced rest intervals aimed at increasing endurance). Flexibility exercises diversified to enhance flexibility, such as pectoral stretching against a wall.

8. Week: Swimming (third level), swan dive (third level), chest expansion, twist, cleopatra (15 repetitions, 3 sets each; reduced rest intervals aimed at increasing endurance).

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics (version 26, IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. The assumptions of normality and homogeneity of variances were evaluated prior to inferential analyses. For within-group comparisons of pre- and post-intervention data, appropriate parametric or non-parametric tests were employed based on data distribution characteristics. Relationships between variables were analyzed using Spearman's rank correlation coefficient. In analyses involving repeated measures, the assumption of sphericity was tested; where violated, appropriate corrections (e.g., Greenhouse-Geisser) were applied. A two-way analysis of variance (ANOVA) was conducted to examine interaction effects, and post-hoc comparisons were performed using the Bonferroni-Dunn test. Statistical significance was set at a p-value of$<.05$. Effect sizes were calculated using eta-squared (η^2) for ANOVA and Cohen's d for pairwise comparisons to interpret the magnitude of observed differences.

Ethical Considerations

All participants were informed about the objectives and procedures of the study, and written informed consent was obtained from each participant prior to data collection. The study protocol was reviewed and approved by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University on March 11, 2021 (Approval No: 772.02-801), and all procedures were conducted in accordance with the Declaration of Helsinki.

Results

The study included 28 participants. Table 1 illustrates the demographic characteristics of the participants. As presented in Table 2, a statistically significant reduction in pain intensity was observed following the intervention when comparing pre and post-treatment scores (p<.05). Significant improvements were also found in cervical flexion and extension range of motion, with post-treatment values exceeding pre-treatment measurements in both directions (p<.05). Although no significant differences were detected between the pre- and post-treatment means of right and left cervical lateral flexion, post-treatment values in both directions demonstrated statistically significant increases compared to baseline (p<.05, Table 2).

With respect to cervical rotation, no side-to-side differences were noted at baseline; however, post-treatment values revealed a higher average rotation angle on the right compared to the left. Moreover, both right and left cervical rotation angles showed significant improvements following the intervention (p<.05).

Table 1.
Descriptive Characteristics of Participants

	Statistics
Age, (Year)	
Mean±SD	46.71±11.54
M (Min;Max)	49 (11.54; 49)
Body Weight, (kg)	
Mean±SD	73.34±10.88
M (Min;Max)	75 (10.88; 75)
Height, (cm) Mean±SD	173.29±10.22
M (Min;Max)	175 (10.22; 175)
BMI, (kg/m2)	
Mean±SD	24.39±2.73
M (Min;Max)	24.44 (2.73; 24.44)
Duration of Pain, (day) Mean±SD	3.82±2.89
M (Min;Max)	3(2.89; 3)
Gender	n (%)
Male Female	13 (46.4) 15 (53.6)
Dominant Side	
Right Left	22 (78.6) 6 (21.4)

Summary statistics for numerical data are presented as mean ± standard deviation

In terms of shoulder mobility, no significant post-treatment differences were observed between the right and left shoulders for flexion, although the right side exhibited lower values at baseline. Notably, shoulder flexion angles increased significantly after the intervention (p<.05). Similar statistically significant improvements were observed for shoulder abduction and external rotation (p<.05, Table 2).

Regarding shoulder extension, no side-to-side differences were evident post-treatment; however, the right side demonstrated lower pre-treatment values.

Table 2.
Descriptive Characteristics of Participants

		Baseline	Post-treatment	*p*
		Mean ±SD	Mean ±SD	
VAS		5.93±1.72	2.46±1.55	**.001**
Neck Flexion		41.64±2.44	44.32±1.16	**.001**
Neck Extension		41.79±3.39	44.39±1.07	**.001**
Neck Lateral Fleksiyon	R	33.75±9.9	41.89±4.27	**.001**
	L	33.96±9.75	41.54±4.26	**.001**
Neck Rotation	R	43.29±14.49	54.29±7.26	**.001**
	L	44.07±14.08	52.93±8.53	**.001**
Shoulder Flexion	R	166.82±11.45	174.07±7.54	**.001**
	L	170.29±7.88	176.04±5.15	**.001**
Shoulder Extension	R	54.21±4.38	57.32±2.84	**.001**
	L	55.54±3.58	58.82±1.91	**.001**
Shoulder Abduction	R	153.29±24.87	176.72±3.99	**.001**
	L	172.54±8.65	176.71±5.95	**.001**
Shoulder Internal Rotation	R	58.96±1.53	79.5±103.18	.303
	L	59.61±0.83	59.93±0.38	.083
Shoulder External Rotation	R	82.00±6.84	86.04±5.43	**.001**
	L	84.36±6.46	87.43±4.57	**.001**

R: Right; L: Left; SD: Standart Deviation. Sections highlighted in bold are statistically significant (p<.05).

Significant increases were recorded for shoulder extension in both shoulders following the intervention (p<.05). Furthermore, measures of shoulder flexibility—specifically internal and external rotation tightness—showed a significant reduction in distance post-treatment, indicating enhanced flexibility (p<.05, Table 2).

According to Table 3, pre-treatment LSST measurements were significantly higher compared to post-treatment averages (p<.05, Table 3).

Table 3.
The Effect of Treatment on Scapular Dyskinesis

	Time				*p*
	Before Treatment		After Treatment		
LSS Test-0^0	1.74±0.92	1.8 (0 ; 4)	0.70±0.42	0.75 (0 ; 1.40)	**.001**
LSS Test-45^0	1.61±1.18	1.5 (0 ; 5)	0.72±0.45	0.95 (0 ; 1.40)	**.001**
LSS Test-90^0	1.38±1.06	1 (0 ; 4)	0.63±0.47	0.75 (0 ; 1.40)	**.001**

Sections highlighted in bold are statistically significant (p<.05).

At the outset of the study, 15 patients (53.6%) exhibited LSS-0 DEGREES test results exceeding 1.5 cm, while by the conclusion of the study, all patients had results below 1.5 cm. Similarly, for the LSS-45 DEGREES test, 13 patients

(46.4%) initially had results above 1.5 cm, with this number decreasing to zero by the end of the study. For the LSS-90 DEGREES test, 10 patients (35.7%) had results above 1.5 cm initially, with this figure also dropping to zero by the end of the study. Statistically significant differences were observed in all positions following treatment (p<.05, Table 4).

Table 4. *Presence of Scapular Dyskinesis in Participants Before and After Treatment*				*p*
		Time		
		Before Treatment	After Treatment	
LSS Test-0^0	1.5 cm below	13 (46.4)	28 (100)	**.000**
	1.5 cm above	15 (53.6)	0 (0)	
LSS Test-45^0	1.5 cm below	15 (53.6)	28 (100)	**.000**
	1.5 cm above	13 (46.4)	0 (0)	
LSS Test-90^0	1.5 cm below	18 (64.3)	28 (100)	**.000**
	1.5 cm above	10 (35.7)	0 (0)	

†: "Chi-square test (χ2), Summary statistics are presented as mean ± standard deviation and Median (Minimum, Maximum) for numerical data, and as Number (Percentage) for categorical data. Sections highlighted in bold are statistically significant (p<.05)."

Discussion

This study aimed to determine the effects of clinical Pilates on scapular pain, joint range of motion and dyskinesis in patients with chronic neck and shoulder pain. The results suggest that clinical Pilates has a positive effect on pain, joint range of motion and scapular dyskinesis.

Systematic review evidence demonstrates that Pilates is more effective than minimal intervention for both pain and disability outcomes in neck pain patients (Martini et al., 2022). Individual RCTs consistently report significant improvements in pain intensity, functional disability, and quality of life measures following Pilates interventions (de Araujo Cazotti et al., 2018; Sahiner Picak & Yesilyaprak, 2023).

While several studies have investigated the effects of Pilates exercises, research focusing specifically on the shoulder remains insufficient (Kibler & McMullen, 2003). Two studies have specifically addressed Pilates exercises on shoulder pain. One study examined the effects of Pilates exercises on shoulder range of motion in women with breast cancer, while another compared the effects of clinical Pilates and conventional exercises on pain and disability in shoulder pain (Atılgan et al., 2017; Keays et al., 2008). More recent studies have shown that Pilates can improve shoulder range of motion and reduce pain in various patient populations, including athletes and older adults (Nithuthorn et al., 2024). Therefore, clinical Pilates exercises could offer a viable treatment option for improving shoulder function across diverse patient groups, including those suffering from chronic shoulder and neck pain.

Studies comparing physical exercise interventions for chronic nonspecific neck pain have not found superior types of physical exercises. Motor control, yoga, Pilates, Tai Chi, Qigong, and strengthening exercises have all demonstrated effectiveness for chronic nonspecific neck pain, albeit with very low-quality evidence (de Zoete et al., 2020). A more recent meta-analysis (2024) found Pilates to be particularly effective in improving both pain and disability scores in patients with chronic musculoskeletal pain, suggesting that Pilates may be superior to other modalities in some patient populations (Cruz et al., 2016). Recent research suggests that Pilates may be an effective intervention for various musculoskeletal disorders, particularly chronic pain syndromes such as fibromyalgia. A systematic review and meta-analysis have demonstrated that Pilates plays a significant role in reducing pain and improving health-related quality of life (HRQOL) in patients with fibromyalgia. However, the authors emphasize that these findings should be interpreted within the context of specific patient demographics and controlled conditions (Nithuthorn et al., 2024).

These findings align with the results of our study. In our study, clinical Pilates interventions were observed to reduce pain and improve shoulder function in individuals with chronic neck and shoulder pain. It can be hypothesized that Pilates may exert its beneficial effects through similar mechanisms in both fibromyalgia and neck-shoulder pain conditions.

A meta-analysis of randomized controlled trials by Martini et al. (2022) concluded that Pilates exercises for neck pain were not superior to other treatments in terms of pain and disability after three months. However, the evidence was deemed weak, highlighting the need for high-quality publications for better analysis (Martini et al., 2022). This points to the need for larger, long-term studies to better understand the long-term benefits and potential superiority of Pilates over other interventions for chronic neck and shoulder pain.

In a study by Özünlü Pekyavaş et al. (2014), no significant relationship was found between scapular dyskinesis and pain severity in individuals with shoulder pain, neck pain, or both (PEKYAVAŞ et al., 2014). However, in our study, scapular dyskinesis was detected in patients before treatment, and significant improvement was observed with clinical Pilates application. Therefore, we believe that adding clinical Pilates to the treatment program in clinical trials of neck and shoulder pain cases can provide significant benefits.

Kibler et al. (2009) suggested that scapular dyskinesis occurs in patients with shoulder pain during scapulohumeral movements. In our study, clinical Pilates aimed to establish scapular symmetry, and further exercises targeting the muscles responsible for scapular dynamic stabilization should be added to achieve more effective results. Targeted strengthening exercises focusing on the rotator cuff and trapezius muscles may offer additional benefits in the management of scapular dyskinesis.

A systematic review evaluating the effectiveness of Pilates in the rehabilitation of various conditions, including chronic neck pain, concluded that Pilates is particularly effective in reducing pain and disability (Zakharova-Luneva et al., 2012). This study confirms the effectiveness of an 8-week clinical Pilates treatment on pain. Given the promising results, Pilates may be considered as an adjunct treatment for neck and shoulder pain, especially in patients with poor posture and scapular dyskinesis.

There is a lack of sufficient scientific research on clinical Pilates exercise approaches for neck and shoulder pain. However, our study demonstrates significant improvement in neck and shoulder pain with clinical Pilates exercises. Further research in this area can raise awareness in clinical practice and help more patients. Evaluation of scapular dyskinesis along with joint mobility is crucial in resolving problems related to neck and shoulder pain. Future studies should also consider including a control group to better assess the specific effects of Pilates compared to other treatment modalities. Our study has some limitations. First, there is a lack of sufficient existing research on the topic, which restricts the depth of our discussion. Second, the absence of a control group is a significant limitation, as it reduces the internal validity of the findings. Additionally, the relatively small sample size limits the generalizability of the results. Future studies with larger sample sizes and the inclusion of control groups are needed to draw more robust and widely applicable conclusions.

Conclusion and Recommendations

Clinical Pilates exercises should be considered an important part of treatment for scapular dyskinesis, particularly in patients with chronic neck and shoulder pain. Further clinical recommendations could address the specific patient groups that may benefit most, such as individuals with poor posture or those recovering from shoulder surgery. Patients with chronic, non-specific neck pain, in particular, may experience the greatest benefit from incorporating Pilates into their rehabilitation.

Given the encouraging results of our study, further research is needed to explore the long-term effects of Pilates and its combined use with other therapeutic interventions. Future studies should aim to involve larger sample sizes and utilize long-term follow-up to assess the sustainability of improvements achieved through Pilates. The effectiveness of Pilates when combined with other treatments such as manual therapy or strengthening exercises could also be evaluated in future trials.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Istanbul Medipol University (Date: March 11, 2021, Number: 772.02-801).
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