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The Effects of Pain and Disability on Balance and Mobility in Shoulder Pathologies

Omuz Patolojilerinde Ağrı ve Özürlülüğün Denge ve Mobilite Üzerine Etkileri

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Öz

Giriş ve Amaç: Çalışmamızın amacı omuz patolojilerinden kaynaklanan ağrı ve özürlülüğün denge ve mobilite üzerine etkisini araştırmaktı.

Gereç ve Yöntemler: Bu çalışma kesitsel tasarımlı bir çalışma olup, omuz sıkışma sendromu, rotator manşet yırtığı veya onarımı veya donuk omuz tanısı alan kırk hasta (40-65 yaş) ile yürütüldü. Omuz ağrısı ve fonksiyonelliği, Omuz Ağrısı ve Dizabilite İndeksi (SPADI) kullanılarak değerlendirildi. Statik denge, hastanın sağ ve sol ekstremitelerinde tek ayak üzerinde durma testi ile dengede kalma süresi ölçülerek değerlendirildi. Alt ekstremite fonksiyonel kuvvetinin ve fonksiyonel mobilitenin değerlendirilmesi için Beş Tekrarlı Otur-Kalk Testi kullanıldı. Çalışmamızda hastaların yürüme ve denge durumları için Tinetti Denge ve Yürüme Testi kullanıldı.

Bulgular: Bu çalışmada hastaların %22,5'inde omuz sıkışma sendromu, %57,5'inde rotator manşet patolojisi, %20'sinde donuk omuz sendromu vardı. Tanılarına göre gruplandırıldığında, SPADI toplam ve alt puanları, beş kez otur-kalk testi, tek ayak üzerinde durma testi ve Tinetti toplam ve alt puanları açısından fark bulunmadı ($p>0,05$). Donuk omuzu olan hastalarda özürlülük alt puanı daha yüksek bulunsa da bu bulgu istatistiksel olarak anlamlı bulunmadı. SPADI'nin ortalama yeti yitimi alt puanı ile Beş Tekrarlı Otur-Kalk Testi arasında anlamlı bir ilişki vardı. ($p<0.05$) Tinetti toplam ve alt puan ortalamaları ile Beş Tekrarlı Otur-Kalk Testi arasında anlamlı bir korelasyon bulunurken, Tinetti Testi toplam ve alt puanları ile Tek Ayak Üzerinde Durma Testi puanları arasında anlamlı bir korelasyon vardı ($p<0.01$).

Sonuç: Omuz problemlerine bağlı özürlülük mobiliteyi etkilemekte ve mobilitedeki azalma denge problemleriyle ilişkili görünmektedir. Bu popülasyonu denge problemlerinden korumak için omuz patolojisi olan hastaların rehabilitasyon programlarından önce postüral kontrolün değerlendirilmesi önemlidir.

Anahtar kelimeler: Ağrı, Denge, Özürlülük, Mobilite, Omuz patolojisi.

Abstract

Aim; The aim of this study to investigate the relationship between pain and disability in shoulder pathologies on balance and mobility.

Method; The present study was a cross-sectional design study and was conducted with forty participants (between 40 and 65 years) with a pathology. related to the upper extremity shoulder such as impingement, rotator cuff tear or repair, frozen shoulder. Shoulder pain and functionality were evaluated using the Shoulder Pain and Disability Index (SPADI). Static balance was evaluated by measuring the duration of standing balance on the patient's right and left extremities with single leg stance test. Five times sit to stand test was used for assessment of the functional strength of the lower extremity and functional mobility. Tinetti Balance and Gait Test was used for gait and balance condition of patients in our study.

Results; 22.5% of the patients had shoulder impingement syndrome, 57.5% had rotator cuff pathology, 20% had frozen shoulder syndrome in this study. No differences were found between three subgroups according to diagnosis in terms of SPADI total and sub scores, five times sit to stand test, single leg stance test and Tinetti total and sub scores ($p>0.05$). Although the disability sub score was found higher in patients had frozen shoulder this finding was not found statistically significant. There was a significant correlation between the mean disability sub score of SPADI and Five times sit to stand test. ($p<0.05$) There was also a significant correlation between the mean Tinetti total and sub scores and Five Times Sit to Stand Test, while Tinetti Test total and sub scores was significantly correlated with the Single Leg Stance Test scores ($p<0.01$).

Conclusion; Disabilities due to the shoulder problems affects mobility and decrease in mobility seems to be associated with balance problems. To protect this population from balance problems, it is important to evaluate the postural control of patients with shoulder pathology before rehabilitation programs.

Keywords: Pain, Balance, Disability, Mobility, Shoulder pathology.

1. Introduction

The most common musculoskeletal problem after neck pain and low back pain is shoulder pain and resulting in loss of workforce and negativity in the continuity of recreational activities (1,2). One in three adult's experiences shoulder pain and limitation of shoulder movements, which affects the functionality of patients and leads to disability (3,4). Problems that cause shoulder pain include diseases such as shoulder impingement, rotator cuff injuries, frozen shoulder, acromioclavicular joint degenerations, calcific tendinitis, and instability (5). Rotator cuff tendinopathy, subacromial impingement syndrome, and frozen shoulder are quite common, with up to 50% of the population experiencing shoulder pain each year (6). These conditions can have a significant impact on quality of life, with a monthly incidence of 18-31% in the general population (7).

There is evidence-based literature on deficiencies in shoulder proprioception, trunk, and lower extremity coordination in patients with shoulder pain due to any pathology (8,9). Smooth and painless upper limb movements are often closely linked to the stability of the trunk, which in turn is closely linked to the stability and balance control of the lower limbs. Any deficiency in trunk and lower extremity stability is tolerated by increasing the speed and strength of the structures around the upper extremity. Due to the lower extremity stability and balance control deficiencies, upper extremities become prone to injuries. It remains unclear whether a lack of balance in individuals with shoulder problems is a cause or consequence for injury (10). Myers et al. argued that lack of proprioception and coordination greatly affects shoulder problems; thus, somatosensory deficiencies in the lower extremities and trunk may cause problems in the upper extremity region (11). A disturbance of one or more sensory inputs from the visual, somatosensory, or vestibular system through the afferent pathways (12,13) leads to impaired balance control and falls (13,14). Also, the pain affects the somatosensory system, leading to decreased balance ability. In addition, the balance control and muscle inhibition pathways caused by pain share some pathways in the central nervous system (8,15) Therefore, the mechanisms of muscle inhibition caused by pain can adversely affect the balance (16).

Individuals with shoulder problems may adopt compensatory movements to alleviate pain or discomfort. These compensations can involve altering their posture, shifting weight distribution, so these changes in movement patterns can affect overall balance and mobility (17). Shoulder problems lead to muscular weakness can impact the ability to stabilize the upper body during various activities, compromising balance and mobility. Additionally, coordination may be affected, leading to difficulties in executing movements smoothly and efficiently. Shoulder problems can limit a person's daily living activities and their ability to reach, lift or carry objects (18). During the assessment before the rehabilitation program, evaluation of balance deficiencies is important not only for the lower extremity problems but also upper extremities pathologies. There is limited published research that

covers all age groups diagnosed with a musculoskeletal system shoulder problem, investigating the relationship between different levels of shoulder pain, balance ability, risk, and fear of fall (19,20). Although it has been shown that the balance of patients with shoulder pain is adversely affected, it is not clear that whether the pain level and disability affect the balance and mobility or not. Therefore, this study aims to investigate the relationship between pain and disability in shoulder pathologies on balance and mobility.

2. Method

2.1. Study Design

The present study was a cross-sectional design study and was conducted from May 2023 to June 2023. The patients were asked to sign an informed consent form that had been approved by the Human Research Ethics Committee of Bezmi Alem University (Approval number 2023/33). This study has been registered on ClinicalTrials.gov with the registration number NCT05828706

2.2. Participants

Forty participants were included in the present study. Inclusion criteria were determined as patients with a pathology related to the upper extremity shoulder such as impingement, rotator cuff tear or repair, frozen shoulder, who were able to communicate, and individuals between the ages of 40-65 who agree to participate in the study. Participants excluded from the study if they were having a vision and audition problem, having another concomitant neurological, psychiatric, or orthopaedic problem other than shoulder pathologies, and pregnancy condition (Figure 1).

The sample of the study was calculated using the G*Power (3.1.9.4) Sample Size Calculator program. According to 95% power, 0.05 type I error probability and 0.50 effect size (Cohen's d) in the calculation, the required sample was found to be at least 36 subjects (21). Forty patients who met the inclusion criteria within the study time were included in the study.

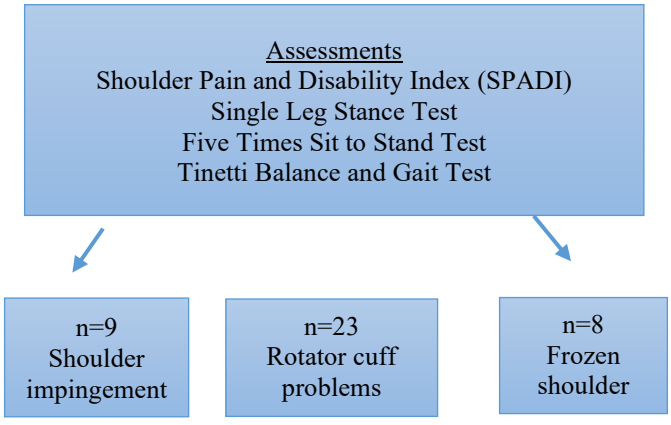
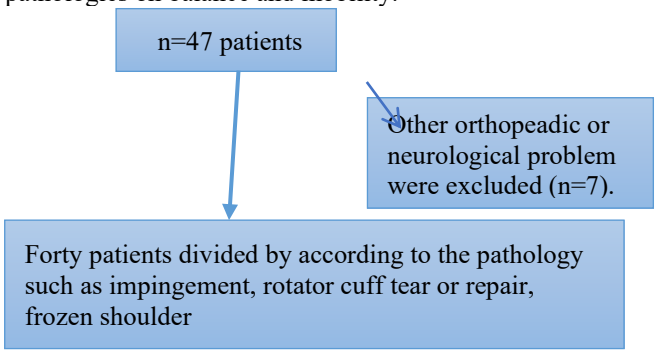


Figure 1. Flowchart of this study



The sociodemographic characteristics (age, sex, body mass index (BMI)) and health status (presence of chronic disease, medication, and history of injury) were questioned. In addition to that diagnosis of disease, duration of disease, presence of other accompanying diseases will be obtained. Assessments were performed by a responsible physiotherapist in a clinical environment.

Shoulder pain and functionality were evaluated using the Shoulder Pain and Disability Index (SPADI). It includes five questions about pain and eight questions about disability (22). The scores were calculated separately and together for pain and disability, respectively. When calculating the score, the total of the points given to the questions in each section was divided by the maximum score that could be obtained from that section and multiplied by 100. Similarly, in the total score, the sum of the points for all questions was divided by 130 and multiplied by 100. Therefore, the scores expressed as percentages varied between 0 and 100. Higher scores indicate more severe pain and disability. The Turkish validation of the SPADI has been performed on patients receiving treatment for various shoulder problems, and it has been stated that this scale has sufficient sensitivity to detect clinical changes (23).

Static balance was evaluated by measuring the duration of standing balance on the patient's right and left extremities with single leg stance test. The time from the moment the patient began to stand on one leg to the first moment when postural stability deteriorated was recorded (24). The cut-off values are determined as if the time is below than 10 seconds it means "there is a balance disorder," and if it is below than 5 seconds it means "there is a risk of falling." (25).

Five times sit to stand test was used for assessment of the functional strength of the lower extremity, transitive movements, fall risk, and dynamic balance and functional mobility (26). The patient was asked to stand up quickly in a position with arms crossed at the shoulders and sit in a standard chair with the back leaning against the chair (27).

Tinetti Balance and Gait Test was used for gait and balance condition of patients in our study. The performance of the subjects during sixteen different balance activities, including nine items related to balance activities and seven items related to gait was scored with integers between 0 and 2 or 0 and 1 (28). As a result of the evaluation made by observation, the scoring was as follows:2 points, correct execution of the specified movement; 1 point, performing the specified movement with adaptations; and 0 points, inability to make the movement. The maximum total possible score was 28. People with a total score of 18 and below are considered "high fall risk", between 19 and 23 is considered "moderate fall risk", 24 and above are considered "low fall risk" (29,30)

2.4. Statistical Analysis

Statistical analysis was performed using the SPSS program. Descriptive statistics were given as mean (standard deviation) or n (%). The normal distribution of the data was analysed with the Kolmogorov-Smirnov test. In the correlation analysis, Pearson analysis was used for data that showed a normal distribution, and Spearman's analysis was used for data that did not comply with normal distribution. One way ANOVA or Kruskal Wallis tests were used for the comparison of data according to shoulder pathology. The level of significance was accepted as $p<0.05$ in all statistical evaluations.

Variables	Shoulder impingement (n=9) mean±SD	Rotator cuff (n=23) mean±SD	Frozen Shoulder (n=8) mean±SD	P value
Duration (months)	11.88 ± 11.41	12.08 ± 18.04	7.37 ± 5.65	0.73
SPADI				
Total	37.11 ± 21.75	51.86 ± 18.35	54.12 ± 17.66	0.11
Pain	45.77 ± 25.79	59.91 ± 17.70	59.5 ± 22.94	0.21
Disability	29.44 ± 18.94	46.04 ± 19.78	49.12 ± 18.38	0.06
FTST	17.61	22.39	18.31	0.48
SLST				
Right	14.00	21.85	23.94	0.15
Left	14.11	21.85	23.81	0.16
Tinetti				
Total	16.5	20.61	24.69	0.33
Gait	15.83	21.11	24.00	0.29
Balance	17.22	20.11	25.31	0.32

3. Results and Discussion

Forty-seven participants were screened for possible for inclusion. Seven participants were excluded due to various reasons (diagnosis of concomitant neurological or orthopaedic problem, being pregnant, unable to communicate for tests etc.), forty participants were included in the study (Figure 1).

The characteristics of the patients with shoulder pathologies, and the type of pathology they have is indicated in Table 1. 22.5% of the patients had shoulder impingement syndrome, 57.5% had rotator cuff pathology, 20% had frozen shoulder syndrome in this study.

No differences were found between three subgroups according to diagnosis in terms of SPADI total and sub scores, five times sit to stand test, single leg stance test and Tinetti total and sub scores ($p>0.05$). Although the disability sub score was found higher in patients had frozen shoulder this finding was not found statistically significant (Table 2).

Table 1. Demographic features of patients

Variables	Mean ± SD / n (%)
Age/years	56.75 ± 10.33
BMI (kg/m^2)	28.93 ± 4.82
Gender	
Male	18 (45 %)
Female	22 (55%)
Education status	
Elementary and high school	36 (90 %)
Higher education	4 (10 %)
Occupation	
Not Working / Retired	28 (70 %)
Private Sector	9 (22.5 %)
Public Officer	3 (7.5 %)
Marital status	
Married	31 (77.5 %)
Widow /Widower	5 (12.5 %)
Single	4 (10 %)
Smoking status	
Non-smoker	33 (82.5 %)
Smoker	7 (12.5%)
Diagnosis	
Shoulder impingement syndrome	9 (22.5 %)
Rotator cuff pathologies	23 (57.5 %)
Frozen shoulder syndrome	8 (20 %)

SD: standard deviation, min: minimum, max:maximum, n:number

There was a significant correlation between the mean disability sub score of SPADI and Five times sit to stand test. ($p<0.05$) There was also a significant correlation between the mean Tinetti total and sub scores and Five Times Sit to Stand Test, while Tinetti Test total and sub scores was significantly correlated with the Single Leg Stance Test scores ($p<0.01$) (Table 3).

Table 2. SPADI, Five times sit to stand and Balance Test Scores of Patients by diagnosis

SD: standard deviation, min: minimum, max:maximum, n:number SPADI: Shoulder Pain and Disability Index, $p<0.05$ SPADI was presented as mean± SD; FTST: Five Times sit to stand, SLST: Single Leg Stance Test and Tinetti Test Scores were presented as mean rank.

In studies conducted on different musculoskeletal diseases that cause widespread chronic pain such as low back pain, knee osteoarthritis, and fibromyalgia, it has been observed that as the severity of pain increases, the balance ability deteriorates, postural

stability oscillations increase, and risk of falling and fear of falling increase (31,32). However, the number of studies looking at this relationship was limited in shoulder pain. Therefore, in our study, the relationship between pain severity and balance, functional mobility was investigated in shoulder pathologies. The present study demonstrated that disability outcomes resulting from shoulder pathology affect mobility. When the disability rate increases, Five Times Sit to Stand time needs longer time to complete.

Table 3. The relationship between SPADI Scores with Five times sit to stand, Single Leg Stance and Tinetti Scores of patients

r p	FTST	SLST Right	SLST Left	TTotal	TGait	TBalance
STotal	0.25 0.10	0.13 0.39	0.12 0.46	-0.10 0.50	-0.18 0.25	-0.04 0.77
SPain	0.19 0.22	0.007 0.96	0.005 0.97	-0.16 0.30	-0.20 0.20	-0.13 0.42
SDisability	0.31 **0.04***	0.22 0.16	0.19 0.23	-0.12 0.46	-0.20 0.21	-0.05 0.72
TTotal	-0.53 **0.00***	0.51 **0.00***	0.45 **0.00***	1.00 0.00*	0.92 0.00*	0.96 0.00*
TGait	-0.62 **0.00***	0.37 **0.01***	0.34 **0.02***	0.92 0.00*	1.00 0.00*	0.80 0.00*
TBalance	-0.43 **0.00***	0.56 **0.00***	0.49 **0.00***	0.96 0.00*	0.80 0.00*	1.00 0.00*

SD: standard deviation, min: minimum, max:maximum, n:number, r: spearman correlation coefficient, STotal, Spain, SDisability represents SPADI: Shoulder Pain and Disability Index; TTotal, TGait, TBalance represents Tinetti
p<0.05

Balance and postural stability were investigated in patients with shoulder pathology by Eker et al. (32) They concluded that shoulder pain is associated with balance and postural stability. On the contrary, Park et al investigated how stabilization exercises carried out in various shoulder joint ranges of motion affected healthy people' static and dynamic balance. The balance of the workouts carried out at all shoulder angles was the same (33).

Rotator cuff problems, shoulder impingement, and frozen shoulder may have different effects on body balance and gait due to different pathophysiological events. Rotator cuff lesions with shoulder stiffness, also known as adhesive capsulitis or frozen shoulder, are characterized by inflammation-mediated adhesions in the subacromial bursa, leading to increased myofibroblast recruitment (34). Shoulder impingement, on the other hand, is a complex condition involving both intrinsic and extrinsic factors in which patients demonstrate scapular compensatory strategies for glenohumeral weakness or loss of motion (35,36). The specific effects of these conditions on balance and gait are not well documented, but the pain and movement limitations associated with these conditions are likely to lead to changes in gait patterns and balance problems. According to our results, there were no differences in balance and gait parameters for each shoulder pathology. This may be because there were unequal numbers of patients with each condition. On the other hand, it may be that common symptoms such as pain and limitation of movement in different shoulder pathologies cause similar balance and mobility problems.

In terms of balance and postural stability skills, Baierle et al. compared patients with moderate-to-severe shoulder pain with healthy people with pathology producing shoulder pain (37). When compared to the healthy group, it was shown that people with moderate and severe shoulder discomfort had worse balance and postural stability. However, there was no correlation between postural stability and balance ability or pain intensity. In our investigation, it was found that the ability to functional mobility performance decreased as disability increased resulting from shoulder pathology. Functional mobility was found to be related with the gait and balance performance so the degree of disability may have an impact on postural stability.

According to Myers et al. (38) proprioception deficiencies influence the central control system, which follows the same patterns, and cause aberrant proprioception throughout the entire muscle chain. Therefore, problems with the shoulder may impact proprioception, disrupt the entire chain, and lead to a loss of stability or balance. According to Treede et al., one of the causes of balance issues may be discomfort (39). Most of the research on shoulder rehabilitation focuses on enhancing muscle balance, joint mobility, strength, and endurance. Despite some writers' hypotheses, there aren't many research showing a connection between shoulder diseases and balance or postural control (40,41). It has been suggested that shoulder pathologies are negatively affected by loss of stability and lack of coordination in proximal body parts. Therefore, in patients with pain and disability caused by shoulder pathologies, consideration should be given to assessing the balance ability and stability of the trunk and lower extremities in addition to traditional therapy approaches.

4. Conclusion

In conclusion, disabilities due to the shoulder problems affects mobility and decrease in mobility seems to be associated with balance problems.

Postural control assessment can be recommended before the rehabilitation programs of patients with shoulder pathology can be added to protect this population against balance problems. This study has some limitations. Shoulder pain and disability were evaluated with the commonly used SPADI, and shoulder pain could not be measured objectively. Also, it should be compared with a healthy control group to indicate that balance problems are caused by shoulder pathologies.

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