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EXAMINATION OF SCAPULAR DYSKINESIS IN INDIVIDUALS WITH ARTROSCOPIC ROTATOR CUFF REPAIR

ARTROSKOPİK ROTATOR MANŞET TAMİRİ GEÇİRMİŞ BİREYLERDE SKAPULAR DİSKİNEZİNİN İNCELENMESİ

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ABSTRACT

Aim: The aim of this study is to examine the presence of scapular dyskinesia in individuals who underwent arthroscopic rotator cuff repair (ARCR).

Methods: This study was conducted in 2018 with approval from the Bolu Abant Izzet Baysal University Clinical Research Ethics Committee. This research comprised 31 individuals between the ages of 45 and 75 who had received acromioplasty and/or tenodesis with ARCR, completed the 12th week following surgery, and were able to perform active shoulder elevation movement of 90˚ or more. Individuals with any neurological or rheumatological disease, a history of upper extremity fractures, and other shoulder injuries or surgery were excluded. Demographic information and scapular dyskinesia data of individuals were recorded in the evaluation form. Scapular dyskinesia was evaluated by using the Scapular Dyskinesia Test (SDT) and Lateral Scapular Slide Test (LSST).

Results: This study consisted of 31 individuals (17 females and 14 males) with an average age of 59.29±7.78 years and a BMI of 30.51±3.48 kg/m^2. Participants had a mean of 24.8 ± 10.59 weeks in the postoperative period. The presence of scapular dyskinesia was found in all individuals in terms of SDT, while 26 individuals were detected in that of LSST. SD types were as follows; Type I, 16 participants; Type II, 8 participants; and Type III, 7 participants.

Conclusion: This study revealed the presence of scapular dyskinesia in long-term outcomes in participants with ARCR. Additionally, our study is one of the two studies in the literature specifically investigating scapular dyskinesia after ARCR. Although the results of our study clearly demonstrate the presence of scapular dyskinesia after ARCR, it is ambiguous whether scapular dyskinesia is a cause or a consequence of shoulder problems.

Keywords: Arthroscopy, Rotator Cuff, Scapular Dyskinesia.

ÖZET

Amaç: Bu çalışmanın amacı artroskopik rotator manşet tamiri (ARMT) yapılan bireylerde, skapular diskinezi varlığının incelenmesidir.

Yöntem: Çalışma, Bolu Abant Izzet Baysal Universitesi Klinik Araştırmalar Etik Kurulu'ndan izin alınarak 2018 yılında gerçekleştirilmiştir. Çalışmaya; 45-75 yaşları arasında olan, ARMT ile akromioplasti ve/veya tenodez işlemi yapılmış olan, cerrahi sonrası 12. haftayı tamamlayan, 90° ve üzeri aktif omuz elevasyonu hareketini yapabilen 31 katılımcı dahil edildi. Herhangi bir nörolojik/romatolojik hastalığı olan, üst ekstremite kırık öyküsü olan, omuzu ilgilendiren başka yaralanma veya cerrahi öyküsü olan katılımcılar çalışmadan dışlandı. Katılımcıların demografik bilgileri ve skapular diskinezi verileri değerlendirme formuna kaydedildi. Skapular diskinezi, Skapular Diskinezi Testi (SDT) ve Lateral Skapular Kayma Testi (LSKT) kullanılarak değerlendirildi.

Bulgular: Çalışmaya, 59.29±7.78 yıl yaş ortalaması ve 30.51±3.48 kg/m^2 BKI'ne sahip 31 katılımcı (17 kadın-14 erkek) dâhil edildi. Katılımcılar, ameliyat sonrası ortalama 24.8 ± 10.59 haftaya sahipti. Skapular diskinezi varlığı, SDT'ne göre katılımcıların tamamında bulunurken, LSKT'ne göre 26 katılımcıda tespit edildi. SD'yi tiplerine göre ayırdığımızda, Tip I, 16 katılımcı; Tip II, 8 katılımcı ve Tip III, 7 katılımcıdan oluşmaktaydı.

Sonuç: Bu çalışma, ARMT'li bireylerde uzun dönem sonuçlarında skapular diskinezinin görüldüğü belirlendi. Ayrıca çalışmamız ARMT sonrası skapular diskineziyi spesifik olarak araştıran literatürdeki iki çalışmadan biridir. Her ne kadar çalışmamızın sonuçları ARMT cerrahisi sonrası skapular diskinezinin varlığını net bir şekilde ortaya koysa da, skapular diskinezinin omuz problemlerinin bir nedeni mi yoksa bir sonucu mu olduğu netlik kazanmamıştır.

Anahtar Kelimeler: Artroskopi, Rotator Manşet, Skapular Diskinezi.

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INTRODUCTION

The scapula provides 3-dimensional movements for coordinating complex shoulder kinematics (Huang et al., 2015). During arm elevation, the scapula synchronously rotates upward, tilts posteriorly, and rotates externally to avoid decreasing the subacromial space (Teixeira et al., 2021). Failure of the scapula to perform these movements due to various shoulder pathologies results in abnormal scapular biomechanics (Huang et al., 2015).

Scapular dyskinesis (SD) is defined as an alteration of static scapular position and scapular motion (Kibler et al., 2002). Abnormal scapular motion narrows the subacromial distance during arm elevation, increases impingement, raises the risk of rotator cuff tears, and impairs the function of the rotator muscles. Dyskinesia can also be present in healthy individuals, and its prevalence is quite high in individuals with shoulder pathology. Kibler et al. revealed that SD is present in 67%-100% of all shoulder injuries (Kibler and Sciascia 2016). Because the scapula acts as a platform for the rotator cuff muscles, RC function or dysfunction is directly related to the scapula dynamics. When the scapular dynamics are optimal contributory, the stabilized scapula allows the rotator cuff to function at an optimal level in both static and dynamic tasks. However, SD negatively affects the biomechanical contributions of the rotator cuff to arm movement and increase strain within the cuff tendon. Therefore, SD might lead to the RC rupture, due to the kinematics changes involved (Song et al., 2021) or occur as a result of rotator cuff injury (Barcia et al., 2021).

Rotator cuff (RC) tears are relevant in clinical practise as they cause shoulder pain and loss of function that is potentially treatable (Teixeira et al., 2021). Rotator cuff repair with arthroscopic technique, among the treatment options, effectively restores the biomechanical stability of the shoulder. After RC repair, the normalization of scapular motion can play an important role in improving the outcomes and maintaining cuff integrity (Song et al., 2021; Teixeira et al., 2021).

Although the biomechanical relationship between RC tear and scapular dyskinesia is known, there is a paucity of studies investigating the incidence of SD after arthroscopic RC repair. To our knowledge, only one study has examined SD following rotator cuff reconstruction. Song et al. investigated the progression of scapular dyskinesis preoperatively and postoperatively in patients with rotator cuff tears and observed an improvement in SD following surgery (Song et al., 2021). To support the literature, we intended to determine if scapular dyskinesia is present in individuals who have undergone rotator cuff repair during the expected time of full participation in activities of daily living. The aim of this study was to investigate the presence of SD in patients with arthroscopic RC repair.

MATERIALS AND METHODS

This cross-sectional observational study was carried out at Bolu between November 2017 and December 2019. Bolu Abant Izzet Baysal University Clinical Researchers Ethics Committee approved the study (No.2017/135), and all participants signed written informed consent forms.

The study population consisted of thirty-one patients who underwent arthroscopic repair surgery for partial thickness rotator cuff tears and completed at least the postoperative 12th week or more. The partial RC tears were determined in the hospital's Radiology Department by taking sagittal and axial planes with MRI scanning. All patients were operated by the same surgeon with the same surgical procedure and underwent a standard postoperative rehabilitation programme after surgery.

Participants who aged 45-75 years old, who underwent the same RC surgical procedure, who had completed the 12th week after surgery, and who performed 90° and above active shoulder elevation movement were included in the study. Participants with a history of other pathologies of the upper extremity (fractures, recurrences, dislocations), in addition to any disease condition (such as a neurological and/or vestibular disease) that is unsuitable to perform the test, were excluded from the study.

Surgical and Rehabilitation Procedure

In surgical procedure, single row/double row repair, biceps tenodesis or tenotomy, or acromioplasty were performed on the participants according to the tear type and the needs of the patient.

In the rehabilitation procedure, all patients received standard physiotherapy and rehabilitation sessions by expert physiotherapists. The standard rehabilitation protocol did not alter over the study period. The rehabilitation programme was as follows:

In the postoperative 0-4 week, a shoulder arm sling was worn by each patient. Cold application, scapular mobilization, active assisted ROM exercises, periscapular and posture exercises were applied to reduce pain and edema and avoid loss of strength.

In postoperative 4-8 week (Home-based exercises); The use of shoulder arm sling has been discontinued. Active ROM exercises, stretching exercises, and posture exercises as home-based exercises were given. In postoperative 8-12 week (Home-based exercises); patients were encouraged to return to daily life. Shoulder and scapula strengthening exercises were recommended.

Outcome Measures

In this cross-sectional study, participants in this study had one evaluation session at least 12 weeks postoperatively. Sociodemographic information and medical histories of the participants were recorded. The Scapular Dyskinesia Test (SDT) and lateral scapular slide test (LSST), which were used for a reliable measurement of scapular motion asymmetry, were preferred.

Scapular Dyskinesia Test

The Scapular Dyskinesis Test (SDT) is a dynamic, visually based test (Kibler et al., 2002). The SDT classification system has shown moderate interrater reliability (κ_w ranged from 0.48 to 0.61, and 75%-82% agreement) (McClure et al., 2009). A camera was used to record the movements of the scapular posterior view and to observe them again. Dumbbells according to their body weights were given to the participants as an external load (1.4 kg for those weighing less than 68.1 kg, and 2.3 kg for those weighing 68.1 kg or more) (McClure et al., 2009). The resting position was defined as the participant's normal posture with the arms at the side of the body, elbows straight, shoulders in neutral rotation, and thumbs pointing forward. Participants were asked to simultaneously elevate their bilateral arms overhead as far as possible to a 3-second count in the "thumb-up" position and then lower the arms slowly after reaching the final degree to a 3-second count. During test, scapular movements were observed from the back, 2 m away (McClure et al., 2009; Kibler et al., 2002). The scapular patterns were classified as a classification system by Kibler et al. (Kibler et al., 2002). SD is categorized into three types (type I: inferior angle prominence; type II: medial border prominence; and type III: superior border elevation). This standard classification is considered the gold standard (Song et al., 2021; Kibler et al., 2002).

Lateral scapular slide test

The LSST is described to measure the static scapula position by Kibler. (Kibler 1998). Scapular dyskinesia is measured by placing the upper extremity at 0°, 45°, and 90° of abduction position in the coronal plane. Measurements were taken bilaterally from two different regions of the scapula; “from the inferior angle of the scapula to the T7 spinous process of the reference vertebra”, and “from the medial border of the spina scapula to the T3 spinous process of the reference vertebra”(Kibler 1998; Odom et al., 2001). Measurements were made with a tape measure. All scapular distance measurements were taken 3 times. The mean was calculated and used for data analysis.

Kibler stated that as a criterion for determining if scapular asymmetry occurs, the distance between the two sides scapulae should differ by more than 1.5 cm (Kibler 1998). In this study, a difference of 1.5 cm or more in any of the 3 positions was used as the threshold value for the presence of scapular dyskinesia.

Statistical analyses were performed using SPSS version 24.0 (SPSS 24 for Windows, Armonk, NY: IBM Corp). Descriptive statistics were used to determine the demographic characteristics, the prevalence of SD, and SD type. Chi-square test was used to determine whether the cause of injury (traumatic or overuse) was a risk factor for the presence of SD. The sample size was determined using GPower 3.1 software (FranzFaul, UniversitatKiel, Germany). To achieve $\alpha < 0.05$ and $\beta = 80\%$, according to the data of the LSST in Tawde and colleagues’study (Tawde et al., 2016), 28 participants were required for each group.

RESULTS

Thirty-one participants (17 females and 14 males) with arthroscopic RC repair were included in this study. The mean age of participants ranged from 51 to 67 years (mean age 59.29±7.78 years).

Participants had a mean of 24.8 ± 10.59 weeks in the postoperative period. The demographic information and clinical information of the participants are shown in Table 1.

Table 1. The demographic and clinical information of participants.

		Study Group (n=31)	
		Mean ± SD	
Age(y)		59.29±7.78	
Height (m)		1.60± 0.08	
Mass (kg)		78.67±8.52	
BMI (kg/m^2)		30.51±3.48	
Post-op period (week)		24.8 ± 10.59	
Duration of symptoms (months)		39.96± 90.44	
		n	**%**
Sex	Females	17	54.8
	Males	14	45.2
Dominant Side	Right	30	96.8
	Left	1	3.2
Surgical Side	Right	26	83.9
	Left	5	16.1
Cause of rupture	Traumatic onset	17	54.8
	Overuse	14	45.2

Abbreviations: BMI, Body Mass Index. SD, Standard deviation. n, number of participants.

The presence of scapular dyskinesia was found in all participants in terms of SDT, while 26 participants were detected in terms of LSST (Table 2). SD types were as follows; Type I, 16 participants; Type II, 8 participants; and Type III, 7 participants. According to the LSST test, the results on the healthy and surgical sides for positions 1, 2, and 3 in the LSST test are given in Table 2. In the LSST test, the presence of scapular dyskinesia was most common in %51.6 of the participants in test position-3 measurement (T7).

With statistical analysis using chi-squared test of the cause of injury (traumatic or overuse) using the chi-square test, there was no significant difference between the presence and absence of SD ($p>0.05$).

Table 2. Present of scapular dyskinesis and results (cm) according to LSST.

		Study Group (n=31)			
		Operation	**Non-operation**	**Scapular Dyskinesia**	
		Mean ± SD	**Mean ± SD**	**n**	**%**
T3	Test Position 1 (Abd 0°)	7.02±1.68	7.16±1.70	9	%29
	Test Position 2 (Abd 45°)	5.77±1.74	6.21±1.99	10	%32.3
	Test Position 3 (Abd 90°)	3.95±1.12	4.06±1.16	0	%0
T7	Test Position 1 (Abd 0°)	10.26±5.36	9.11±1.55	6	%19.4
	Test Position 2 (Abd 45°)	9.10±1.39	9.36±1.31	10	%32.3
	Test Position 3 (Abd 90°)	10.16±1.99	10.36±2.15	16	%51.6

Abbreviations: Abd, Abduction movement

DISCUSSION

This study revealed the presence of scapular dyskinesia in long-term outcomes in participants with arthroscopic RC repair. Additionally, our study is one of the two studies in the literature specifically investigating scapular dyskinesia after arthroscopic RC repair (Song et al., 2021).

A systematic review concluded that both the dominant hand and older age, namely age above 60 years, were associated with a higher risk of RCT tears (Sayampanathan and Andrew 2017). The dominant hand tends to be used more in activities of daily living and is, therefore, exposed to higher stress. Adding older age to dominant hand use may reduce the tensile strength and elasticity of RC

tendons, making them vulnerable to RC rupture (Sayampanathan and Andrew 2017; Sambandam et al., 2015). In our study, the risk of rupture in the RC tendons may have increased since almost all of the participants had symptoms on the dominant side and an advanced age. Besides, in our study, it was noticed that the participants were at the obesity limit according to their BMI. In the cohort study with patients with symptomatic RC tears, high BMI was determined as a factor increasing the probability of RC rupture (Grusky et al., 2021). We consider that the high BMI is an important result for the understanding of the population with RC rupture.

Scapular motion asymmetry after arthroscopic RM repair has only been studied by Song et al. (Song et al., 2021) They released that 65% of patients with rotator cuff tears had SD preoperatively and this proportional prevalence decreased after surgery. In addition, they emphasised that SD recovery may be associated with increased shoulder function (Song et al., 2021). In our study, scapular dyskinesia was present in all patients with ruptures according to SDT and in 83.8% of patients according to LSST. It is unclear whether this considerable ratio increased or decreased compared to preoperatively. However, the participants in our study had a long duration of symptoms (a mean of 39,96 ± 90,44 months) and an average of half had injuries due to overuse. This chronicity of the condition may have led to loss of strength and biomechanical compensations in the scapula stabilizer muscles. Besides, Kibler et al. stated that the scapula has problems performing its normal dynamic task after injuries in which the muscles that provide the dynamic stabilisation of the scapula are affected (Kibler and McMullen 2003). We emphasised the presence of scapular dyskinesia in participants with arthroscopic RM repair in the same line in the literature.

In our study, the number of participants with SD according to SDT and LSST results was different from each other, although it was not statistically significant. In SDT, scapula movements were assessed as multidirectional and dynamic, and more muscles are actively involved (Lopes et al., 2015); nevertheless, scapula movements were evaluated statically in 3 different positions, and less muscles are concerned in LSST (Wasave and Varghese 2018; McClure et al., 2012). Therefore, we think that the difference in the prevalence of SD is due to fundamental differences in the evaluation procedures of the tests. As mentioned earlier, performing active shoulder movements with extra load changes the scapulohumeral rhythm, thereby SD can be seen more clearly than in the static position. The most common type of dyskinesia in patients undergoing arthroscopic RC surgery was type 1 (inferior angle prominence). Song et al. reported that more than half of SD cases with rotator cuff repair and subacromial decompression had a type 1 pattern, which is consistent with our results (Song et al., 2021). In our study, there was no specific application for SD within the physiotherapy protocol; it was rather a standard treatment. The lower trapezius and rhomboid muscle strengthening exercises for type 1 can be added to the postoperative rehabilitation program.

In the LSST, half of the participants had scapular asymmetry in the 90° abduction position (test position 3). Wickham et al. emphasised that the supraspinatus and middle trapezius muscles showed the peak intensity at 90° abduction in the results of the EMG activities (Wickham et al., 2010). Similarly, Lopes et al. reported that upper trapezius activity has greater activation during 30° to 60° elevation of the arm in individuals with shoulder impingement (Lopes et al., 2015). It seems that these muscle groups are insufficient in stabilizing the scapula after arthroscopic RM repair. Consideration of the rotator cuff muscles and scapula stabilisers concurrently in the postoperative rehabilitation programme might be advantageous.

According to the meta-analysis results of Hogan et al. SD (Hogan et al., 2021) was not associated with the development of overuse or traumatic shoulder injuries as in line with our study. They state that form of injuries can be multifactorial. This complexity requires identifying risk factors in the biomechanical and psychosocial domains and the interaction between these factors. Similarly, Achenbach et al. emphasized that SD was not a risk factor for an overuse shoulder injury in elite handball players (Achenbach et al., 2020). In future studies, defining the cause of injury more specifically such as falling, heavy lifting, or traffic accidents, and also examining biomechanical factors such as muscle strength may reveal the risks that may lead to the presence of SD.

This study has several limitations. Firstly, the lack of dyskinesia data in the preoperative period is our major limitation. Therefore, our study did not have the power to show the improvement in dyskinesia after surgery and physical therapy. Secondly, whether the presence of SD that is independent of asymmetry is an impairment that is related to tear, or whether it represents just the result of tear, is not known. Lastly, we preferred SDT and LSST in our study because the tests are generally accepted

and easy to access. However, evaluation of scapular motion asymmetry with 3D kinematics could enable us to comment on the results in more detail.

Participants have completed at least 12 weeks. Although this period seemed to be sufficient time for the adaptation of daily living activities of individuals (Chalmers et al., 2018), the postoperative evaluation periods were relatively short (mean 24.8 ± 10.59 weeks). Scapular asymmetry may change with at least one-year follow-up with functional status. In addition to contributing to future research, the results of current study can aid in the development of specialised rehabilitation techniques for SD following RC repair.

CONCLUSIONS

Our study is one of the few studies examining the presence of scapular dyskinesia after arthroscopic RM repair. Although it is debated whether scapular dyskinesia is a cause or a consequence of shoulder problems, our study clearly demonstrated the presence of scapular dyskinesia in patients after RM surgery. In future studies, scapular motion asymmetry should be evaluated with 3,6, and 12 months of follow-up as well as preoperatively and postoperatively to make a clearer contribution to the literature. Additionally, to state the development of scapular dyskinesia after surgery more definitely, in future studies, it may be necessary to evaluate other factors that may cause scapular dyskinesia, such as posture, posterior capsule tension, and joint range of motion. Much more research is needed to fill this gap in the literature.

Conflict of interest

The authors report no actual or potentialconflicts of interest.

Author Contributions

Plan, design: HK, ANN; **Material, methods, and data collection:** HK, ANN, BYD; **Data analysis and comments:** HK; **Writing and corrections:** HK, BYD.

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