ACTA ORTHOPAEDICA et TRAUMATOLOGICA TURCICA
www.aott.org.tr

Research Article

Anatomical relationships of the transmuscular portal to its surrounding structures in arthroscopic treatment of superior labrum anterior posterior lesions: A cadaveric study and preliminary report

Turhan Özler[1], Onur Kocadal[1], Gülşah Zeybek[2], Amaç Kıray[2], Gökhan Meriç[1]

[1]*Department of Orthopaedics and Traumatology, Yeditepe University, School of Medicine, İstanbul, Turkey*
[2]*Department of Anatomy, Dokuz Eylül University, School of Medicine, İzmir, Turkey*

ARTICLE INFO

Article history:
Submitted April 12, 2019
Received in revised form
January 27, 2020
Last revision received
August 10, 2020
Accepted November 8, 2020

Keywords:
Transmuscular portal
Suprascapular nerve
Axillary nerve
Rotator cuff
Anatomy

ORCID iDs of the authors:
T.Ö. 0000-0002-1115-2435;
G.Z. 0000-0001-6580-7882;
A.K. 0000-0002-4504-650x;
G.M. 0000-0001-5606-0406.

ABSTRACT

Objective: This study aims to investigate the anatomical relationships of the transmuscular portal to its surrounding structures in arthroscopic treatment of superior labrum anterior posterior (SLAP) lesions in a human cadaveric model.

Methods: In this anatomic study, bilateral shoulder girdles of 12 adult formalin embalmed cadavers were used. All cadavers were male, and the mean age was 63.4±7.3 years. The portal entry point was determined as midway between the anterior and posterior borders of the acromion, approximately 1 cm lateral from the edge of the acromion. After a guidewire was placed in the glenoid cavity at the 12 o'clock position where the SLAP lesion typically occurs, a switching stick was inserted there. Each glenoid was then drilled with a 2.4 mm drill through an arthroscopic cannula. Subsequently, anatomical dissection was executed to assess the relationship of the transmuscular portal with the suprascapular nerve, axillary nerve, supraspinatus tendon, acromion, and biceps tendon. Lastly, the shortest distance between the aforementioned structures with the drill was measured by a sensitive caliper to determine whether there was a penetration of the structures. Differences between the right and left sides were analyzed.

Results: The mean distance between the portal and the axillary nerve was 55.5 mm±6.0 mm, and the mean length of the suprascapular nerve was 61.2 mm±7.0 mm. The mean distance between the portal and the supraspinatus tendon was 2.8 mm±1.5 mm. No penetration of the axillary nerve, suprascapular nerve, and supraspinatus tendon was observed in any cadaver. No differences were detected for measured anatomical parameters between the right and left sides ($p>0.05$).

Conclusion: Findings from this cadaveric study revealed that the transmuscular portal may allow for a reliable anchor placement without any nerve or tendon penetration during arthroscopic SLAP repair.

Level of Evidence: Level V

Introduction

Superior labrum anterior posterior (SLAP) lesions are one of the common causes of shoulder pain (1) Recently, arthroscopic approaches have become popular in the surgical treatment of SLAP lesions. The most widely accepted surgical treatment modality for SLAP lesions is the reattachment of the unstable biceps anchor to the original insertion site (2). Arthroscopic approaches allow a detailed evaluation of the glenohumeral joint and the treatment of the subacromial and intraarticular pathologies.

The anterior, anterosuperior, and posterior visualization portals are the most preferred in the treatment of SLAP lesions and labral pathologies by arthroscopic surgery (2). These portals allow anchor implantation on the anterior region of the glenoid. However, anchor placement can be challenging in the posterosuperior portion of the glenoid by conventional arthroscopic portals during SLAP repairs. For this reason, accessory portals such as transacromial, trans-rotator cuff, Neviaser, rotator interval, and transmuscular portals were suggested for the placement of the suture anchors (3-5).

The transmuscular portal, also known as the Rothman-lateral portal, is located midway between the anterior and posterior edges of the acromion, approximately 1 cm lateral to the acromial border (3). Suprascapular nerve injury and medial wall perforation are potential complications of the anchor placement of the posterior part of the glenoid (1, 6-8). To the best of our knowledge, there is no study evaluating the anatomical relationship between the transmuscular portal and its surrounding structures.

In this cadaveric anatomic study, we aimed to evaluate the relationship between the transmuscular portal and its surrounding anatomical structures. Our hypothesis is that the transmuscular portal is a safe accessory portal for anchor insertion of the posterosuperior part of the glenoid.

Materials and Methods

This study was carried out following the approval of the local ethics committee. In this study, the bilateral shoulder girdles of 12 adult formalin embalmed cadavers were used. All cadavers were male, and the mean age of the cadavers was 63.4±7.3 years. In the cadavers, the presence of osteoarthritis, rotator cuff damage, and biceps tendon damage were determined as exclusion criteria. No specimens were excluded.

Corresponding Author:
Gökhan Meriç
drgokhanmeric@gmail.com

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Cite this article as: *Özler T, Kocadal O, Zeybek G, Kıray A, Meriç G. Anatomical relationships of the transmuscular portal to its surrounding structures in arthroscopic treatment of superior labrum anterior posterior lesions: A cadaveric study and preliminary report. Acta Orthop Traumatol Turc 2021; 55(1): 38-41.*

DOI: 10.5152/j.aott.2021.19197

The portal entry point was determined as midway between the anterior and posterior borders of the acromion, approximately 1 cm lateral from edge of the acromion (3). A guide wire was placed in the glenoid cavity at the 12 o'clock position, where the SLAP lesion could occur. A longitudinal 3 cm incision was made at 2 cm inferior and 1 cm medial to the posterior corner of the acromion (arthroscopic posterior portal entrance point), and the location of the guide wire at 12 o'clock was evaluated by direct under-visualization. Then, a switching stick was placed in the glenoid at 12 o'clock. An arthroscopic cannula was put through the switching stick. Each glenoid was drilled with a 2.4 mm drill at the 12 o'clock position by an experienced orthopedic sports medicine surgeon. The path of the drill hole was determined using a special drill and guide (Arthrex, Naples, FL) (7).

Anatomical dissection was performed to evaluate the relationship of the transmuscular portal with the suprascapular nerve, axillary nerve, supraspinatus tendon, acromion, and biceps tendon. Skin and subcutaneous tissue were removed. The shortest distance between the axillary nerve, suprascapular nerve, and supraspinatus tendon with the drill was measured by a 0.01 mm sensitive caliper (Digital ABS, AOS, Mitutoyo, JAPAN) to determine whether there was penetration of suprascapular nerve, axillary nerve, and supraspinatus tendon in the cadavers. All measurements on the cadavers were carried out by an experienced anatomy specialist who is one of the authors of the study. Angular measurements were performed using a goniometer. All measurements were performed 3 times, and the mean of the measurements were recorded (9).

To evaluate the relationship between the transmuscular portal and the biceps tendon, the shortest distance between the drill and the point where the biceps tendon passes through the bicipital groove was measured. The angle between the long axis of the biceps tendon and the drill was recorded.

To evaluate the relationship between the transmuscular portal and the acromion, the shortest distance between the drill and anterior corner of the acromion was measured. The angle between the drill and the superior surface of the acromion was also measured (Figure 1, 2).

Statistical analysis

Statistical analysis was performed with the the Statistical Package for Social Sciences version 20 (IBM SPSS Corp., Armonk, NY, USA) program. Anatomical relationships were evaluated using descriptive statistics such as mean and standard deviation. The Mann-Whitney-U test was used to evaluate the difference between the two sides. The statistical significance limit was set at 0.05.

Results

The mean distances between the transmuscular portal and the axillary and suprascapular nerves were 55.5 mm±6.0 mm and 61.2 mm±7.0 mm, respectively. There was no drill penetration of the suprascapular nerve, axillary nerve, and/or supraspinatus tendon in any of the samples.

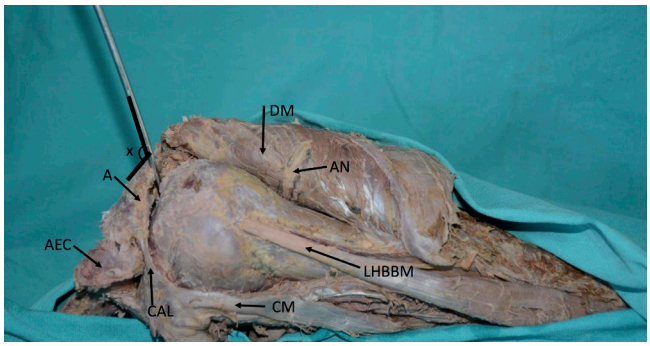

Figure 1. Lateral view of the shoulder: acromion (A), acromial end of the clavicle (AEC), coracoacromial ligament (CAL), coracobrachial muscle (CM), long head of biceps brachii muscle (LHBBM), axillary nerve (AN), deltoid muscle (DM), and the angle between the portal and the superior surface of the acromion (X)

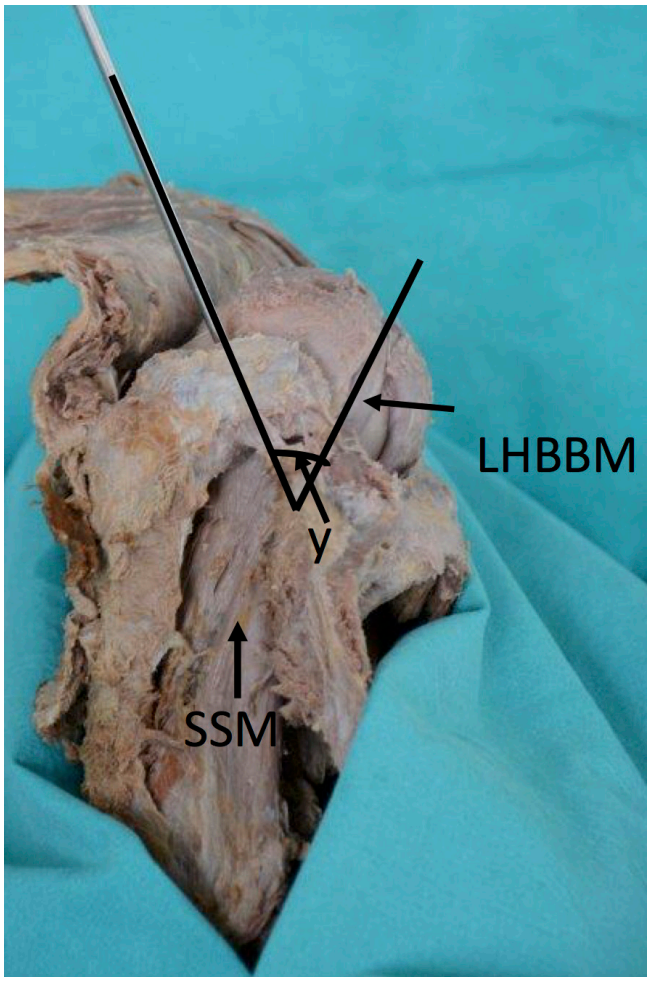

Figure 2. Anterosuperior view of the shoulder: Long head of biceps brachii muscle (LHBBM), subscapuler muscle (SSM), and angle between the portal and LHBBM (Y)

Table 1. Anatomical relationships between transmuscular portal (TM) and its surrounding structures

	Right (n:12)	Left (n:12)	Total (n:24)	p
The mean angle between upper acromial surface and TM (°)	47.1±7.8	47.4±4.3	47.2±6.1	0,83
The mean angle between biceps between and TM (°)	62.0±7.8	60,3±12.1	61.2±10.0	0,70
The mean distance between axillary nerve and TM (mm)	56.1±4.7	55.1±7.3	55.6±6.0	0,84
The mean distance between suprascapular nerve and TM (mm)	58.4±6.9	63.9±6.2	61.2±7.0	0,08
The mean distance between biceps tendon and TM (mm)	28.0±3.2	29.1±5.7	28.5±4.6	0,38
The mean distance between supraspinatus tendon and TM (mm)	2.8±1.7	2.9±1.3	2.8±1.5	0,68
Distance between upper acromial surface and TM (mm)	16.2±0.9	16.3±1.4	16.3±1.2	1,00

Values are presented as mean ± standard deviation. Mann-Whitney U test was used for comparisons

The mean distances between the transmuscular portal and the biceps tendon, supraspinatus tendon, and anterior acromial edge were 28.5 mm±4.6 mm, 2.8 mm±1.5 mm, and 16.3 mm±1.2 mm, respectively.

The mean angles between the transmuscular portal and the upper acromial surface and biceps tendon were 47.2° ± 6.1° and 61.2° ± 10.0°, respectively. There was no significant difference between the right and left sides of all the measurements ($p>0.05$). The data for all measurements are summarized in Table 1.

Discussion

The main finding of this study is that the transmuscular portal is a safe portal away from the rotator cuff tendon and neural structures during the anchor placement of the posterosuperior glenoid. In this study, no damage was observed in the axillary nerve, suprascapular nerve, or supraspinatus tendon, which clearly demonstrates that the results support the study hypothesis.

Difficulties faced in the surgical treatment of SLAP lesions are as follows: technical difficulty of the implantation of the anchors, iatrogenic nerve damage, and medial wall perforation (10). Anatomic studies revealed that the labral attachment of the long head of the biceps tendon was extended approximately 55% to the posterior labrum, 37% to anterior and posterior labrum, and only 8% to the anterior labrum (11). The standard anterosuperior portal allows easy access to the anterosuperior quadrant of the glenoid during SLAP repairs (2). In contrast, standard arthroscopic portals sometimes do not allow anchor implantation of the posterosuperior glenoid. For this reason, some surgical modifications have been described, such as the use of accessory portals or curved anchors (3-5, 10) These portals may provide a more appropriate approach angle during surgery (12).

The transmuscular portal is one of the accessory portals that allows anchor placement to the posterior part of the glenoid. The number of studies evaluating the clinical outcomes of SLAP repairs using the transmuscular portal is very limited. In a retrospective study evaluating 30 overhead athletes using the transmuscular portal due to SLAP lesion repair, the rate of return to preinjury activity level was 84.1%, and the overall satisfaction rate was reported as 93.3% (13). Due to the lack of clinical studies, it is difficult to estimate complication rates associated with the use of this portal.

Nerve injuries are rare but serious complications in the treatment of SLAP lesions. The incidence of neural injuries was reported as 0.28% in a retrospective study evaluating 4975 SLAP repairs (14). Suprascapular nerve injury has been reported during anchor placement of the posterior glenoid (12). It has been suggested that at the level of the suprascapular notch, narrow posterosuperior glenoid rim is associated with iatrogenic suprascapular nerve injury during arthroscopic repair (10). In a previously performed anatomic cadaveric study in which the anchor placement was carried out using the transmuscular portal, no iatrogenic suprascapular nerve injury was reported during the anchor placement to the 12 o'clock position in the glenoid (1). In this study, the average distance between the suprascapular nerve and the portal line was 61.2 mm, and there was no penetration of the nerve during drilling, which is in agreement with other reports in the literature.

The axillary nerve has the risk of injury to the portals on the lateral side of the acromion during arthroscopic interventions. In the lateral anterior, lateral posterior, Wilmington, superolateral, and trans-rotator cuff portals, the mean distances between portals and axillary nerves were reported as 70, 56, 55, 58, and 53 mm, respectively (15). In this study, it was measured as 55.5 mm. To the best of our knowledge, this study is the first to evaluate the relationship between the transmuscular portal and the axillary nerve.

In the surgical treatment of posterior extended SLAP lesions, portals located at the lateral side of the acromion can be used. These portals can be listed as anterolateral, posterolateral, transmuscular, and trans-rotator cuff.[2] Although access to the posterior part of the glenoid is technically easy from the lateral side of the acromion, poorer surgical outcomes were reported after SLAP repair in which portals were placed through the rotator cuff (16). Unlike in the use of trans rotator-cuff portal, the posterior portion of the glenoid can be accessed without any penetration of the tendon using the transmuscular portal (3). In this study, tendon penetration was not detected in any cadaver, as reported in the literature.

The treatment of subacromial impingement syndrome with arthroscopic surgery, portals located on the lateral side of the acromion are frequently used. In our clinical practice, we use the transmuscular portal for SLAP lesions as well as interventions for the subacromial region. The transmuscular portal allows intervention in selected cases of posterior extending SLAP lesions with accompanying subacromial impingement syndrome without the additional portal.

This study has several limitations. The main limitation of the study was the use of embalmed cadavers instead of fresh frozen cadavers. However, there are anatomical studies in which the arthroscopic portals are evaluated via embalmed cadavers (7, 15). In addition, the average age of the cadavers used in the study is relatively high, which can be considered as another limitation as SLAP lesions are seen in relatively younger population. In this study, relationship between axillary nerve and transmuscular portal was evaluated using shortest distance technique (15). However, relationships between terminal branches of the axillary nerve and portal were not evaluated. Investigation of the superior branch of the axillary nerve may provide detailed information about injury risk of this anatomical structure. The strength of the study can be expressed as a relatively sufficient number of samples.

The transmuscular portal used in the repair of SLAP lesions is a safe portal that can prove to be effective during the anchor placement of the posterosuperior part of the glenoid. In contrast, prospective randomized studies are needed to evaluate the functional results and complications of SLAP repairs performed using the transmuscular portal.

Ethics Committee Approval: Ethics committee approval was received for this study from the Local Ethics Committee of Dokuz Eylül University, School of Medicine (Decision no. 2013/13-03, date, 24.05.2018).

Informed Consent: N/A.

Acknowledgments: We thank Dr. Anita L. Akkas (PhD in English Literature) for contributing to the English editing.

Author Contributions: Concept - T.Ö., O.K., G.Z., A.K., G.M., M.K.; Data Collection and/or Processing - G.Z., A.K.; Literature Review - O.K.; Writing - T.Ö., O.K., G.M.; Critical Review - G.M.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Kocaoğlu B, Ülkü TK, Sayılır S, Özbaydar MU, Bayramoğlu A, Karahan M. Drilling through lateral transmuscular portal lowers the risk of suprascapular nerve injury during arthroscopic SLAP repair. Knee Surg Sports Traumatol Arthrosc 2017; 25: 3260-3. [Crossref]
2. Oh JH, Kim SH, Lee HK, Jo KH, Bae KJ. Trans-rotator cuff portal is safe for arthroscopic superior labral anterior and posterior lesion repair: Clinical and

radiological analysis of 58 SLAP lesions. Am J Sports Med 2008; 36: 1913-21. [Crossref]
3. Ciccotti MG, Kuri JA, 2nd, Leland JM, Schwartz M, Becker C. A cadaveric analysis of the arthroscopic fixation of anterior and posterior SLAP lesions through a novel lateral transmuscular portal. Arthroscopy 2010; 26: 12-8. [Crossref]
4. Morgan RT, Henn RF, 3rd, Paryavi E, Dreese J. Injury to the suprascapular nerve during superior labrum anterior and posterior repair: Is a rotator interval portal safer than an anterosuperior portal? Arthroscopy 2014; 30: 1418-23. [Crossref]
5. O'Brien SJ, Allen AA, Coleman SH, Drakos MC. The trans-rotator cuff approach to SLAP lesions: technical aspects for repair and a clinical follow-up of 31 patients at a minimum of 2 years. Arthroscopy 2002; 18: 372-7. [Crossref]
6. Bouliane M, Beaupre L, Ashworth N, Lambert R, Silveira A, Sheps DM. Suprascapular nerve injury during arthroscopic superior labral repair: A prospective evaluation. Knee Surg Sports Traumatol Arthrosc 2015; 23: 517-22. [Crossref]
7. Chan H, Beaupre LA, Bouliane MJ. Injury of the suprascapular nerve during arthroscopic repair of superior labral tears: an anatomic study. J Shoulder Elbow Surg 2010; 19: 709-15. [Crossref]
8. Yoo JC, Lee YS, Ahn JH, Park JH, Kang HJ, Koh KH. Isolated suprascapular nerve injury below the spinoglenoid notch after SLAP repair. J Shoulder Elbow Surg 2009; 18: e27-9. [Crossref]
9. Sando MJ, Grieshober JA, Kim H, Dreese JC, Henn RF, 3rd. Evaluation of risk to the suprascapular nerve during arthroscopic SLAP repair: Is a posterior portal safer? Arthroscopy 2018; 34: 389-95. [Crossref]
10. Grieshober JA, Palmer JE, Kim H, et al. Comparison of curved and straight anchor insertion for SLAP repair: A cadaveric study. Arthroscopy 2018; 34: 2757-62. [Crossref]
11. Vangsness CT, Jr., Jorgenson SS, Watson T, Johnson DL. The origin of the long head of the biceps from the scapula and glenoid labrum. An anatomical study of 100 shoulders. J Bone Joint Surg Br 1994; 76: 951-4. [Crossref]
12. Kim SH, Koh YG, Sung CH, Moon HK, Park YS. Iatrogenic suprascapular nerve injury after repair of type II SLAP lesion. Arthroscopy 2010; 26: 1005-8. [Crossref]
13. Neuman BJ, Boisvert CB, Reiter B, Lawson K, Ciccotti MG, Cohen SB. Results of arthroscopic repair of type II superior labral anterior posterior lesions in overhead athletes: assessment of return to preinjury playing level and satisfaction. Am J Sports Med 2011; 39: 1883-8. [Crossref]
14. Weber SC, Martin DF, Seiler JG, 3rd, Harrast JJ. Superior labrum anterior and posterior lesions of the shoulder: incidence rates, complications, and outcomes as reported by American Board of Orthopedic Surgery. Part II candidates. Am J Sports Med 2012; 40: 1538-43. [Crossref]
15. Meyer M, Graveleau N, Hardy P, Landreau P. Anatomic risks of shoulder arthroscopy portals: anatomic cadaveric study of 12 portals. Arthroscopy 2007; 23: 529-36. [Crossref]
16. Cohen DB, Coleman S, Drakos MC, et al. Outcomes of isolated type II SLAP lesions treated with arthroscopic fixation using a bioabsorbable tack. Arthroscopy 2006; 22: 136-42. [Crossref]