CASE REPORT Eur J Anat, 25 (5): 601-606 (2021)

Unusual case of supraspinatus tear

Michał Szlęzak[1,2], Aleksander Kwiatkowski[2,3], Robert Warnecki[4], Grzegorz Bajor[3]

[1] *Association of Neurophysiological-Orthopaedic Manipulative Physical Therapists, Poland*

[2] *Fizjosport Physiotherapy Center, Gliwice*

[3] *Department of Human Anatomy Medical University of Silesia, Katowice, Poland*

[4] *Private Orthodontic Medin, Opole*

SUMMARY

One of the most frequent causes of shoulder pain is the damage of the rotator cuff tendon. Its etiology is multifactorial and the symptoms often require prompt medical intervention. The glenohumeral joint is one of the largest and most complex joints in the human body, so it is very important to understand the many anatomical and pathological variations which may occur. One of such pathological variations is shoulder pain, which might be the result of an unusual rupture of the supraspinatus muscle. In this article we report a rare case of tearing of this muscle and creating of an additional attachment on the lesser tubercle. Moreover, the body produced a bursa that lines the inner layer of the shoulder skin. This work is needed by clinicians because it shows how, despite the massive damage to the muscle and the cartilage structures, the passive range of motion is maintained, and it also shows the role of the synovial bursa in the pathophysiology process. It is very important to learn more about anatomical and pathological variations in order to properly manage shoulder pain and dysfunctions.

Key words: Muscle tear – Supraspinatus – Rotator cuff – Tendon – Shoulder

Corresponding author:
Michał Szlęzak. Medical University of Silesia, Department of Anatomy, The School of Health Sciences in Katowice, Medyków 12, 40-742 Katowice, Poland. E-mail: michal@fizjosport.pl

INTRODUCTION

The complex structure of the glenohumeral joint endows the shoulder with the utmost mobility of any major joint in the human body. This characteristic is primarily due to a limited interface between the humerus and the scapula, requiring the presence of a large network of ligaments tendons, and other connective tissue elements to provide stability and allow for functional movement (Huegel et al., 2015). However, due to the complexity of the structures surrounding the shoulder joint, it is exposed to overload and frequent injuries such as tendinopathy and rotator cuff tears.

The glenohumeral joint is a multi-axis spherical free joint between the head of the humerus and the articular cavity of the scapula; it results in greater mobility of the arm at the cost of reduced stability.

Apart from the six basic movements, circumduction and movements in the horizontal plane are also possible. The shoulder blade moves along with the humerus in relation to each other according to a constant pattern: the scapulobrachial rhythm.

Although the humeral head is much larger than the glenoid cavity, their curvatures differ by as little as 1% (Mehta et al., 2003). Articular surface is enlarged by the labrum glenoidale, genus

Submitted: September 22, 2020. **Accepted:** February 1, 2021

fibrous cartilage, which widens the cavity and makes its concavity visible. The ligaments and the joint capsule are attached to the labrum.

The shape and concavity of the glenoid fossa may vary from person to person. On the outer side of the head of the humerus is the greater tubercle and on the inside the lesser tubercle. There is a bicipital groove between the above-mentioned tubercles (Bochenek et al., 1990).

Connection between the humerus and a scapula is formed by four muscles (supraspinatus, infraspinatus, teres minor and subscapularis); their insertions are very tightly connected with the inside of the joint capsule.

The muscles of the rotator cuff work as a whole and secure the head of the humerus in the articular cavity — they stabilize the shoulder joint in various positions, especially during abduction.

The supraspinatus is one of the four rotator cuff muscles of the shoulder and plays an important role in the dynamic upward stabilization of the humeral head within the glenoid fossa (Burke et al., 2002). It begins at the supraspinatus fossa on the supraspinatus fascia. The fibers converge to the side and end in a strong and short tendon on the greater tubercle of the humerus. The tendon also attaches to the joint capsule. The supraspinatus tendon is separated by a bursa subacromial from the coraco-acromial ligament, the shoulder process of the scapula and the brachial muscle.

Musculus supraspinatus is responsible for shoulder abduction, external rotation and tightening of the articular capsule. This muscle is not very variable individually (Bochenek et al., 1990).

Rotator cuff lesions (RCL) are one of the most common conditions affecting the shoulder — studies have found that16-40% of all shoulder complaints are linked with impingement related tendinopathies, which are often the precursor for rotator cuff tears (Neer et al., 2005). The aetiology of rotator cuff diseases is multifactorial, but the tendon supraspinatus is particularly prone to injuries (Benson et al., 2010), especially because of a sudden, violent fall, most often on a straightened upper limb. It can also be accompanied by damage to other soft structures, shoulder dislocation or even a collarbone or humerus fracture. Another reason may be a single, very heavy load on this muscle or repeated repetition of certain movements.

Rotator cuff lesions have considerable variability in location, tear pattern, functional impairment, and repairability.

Full thickness disruption of the lateral tendon stump is the most frequent type of RCL, comprising approximately 90.1% of all surgically treated lesions. Tendinous lesions most commonly involve the posterosuperior cuff. (Barth et al., 2006).

Full-thickness posterosuperior tears come in a variety of patterns. The most common categories include crescent tears, L- and reverse L-shaped tears, and U-shaped tears accounting respectively for 40%, 30% and 15% of posterosuperior rotator cuff lesions (Davidson et al., 2010). Recognition of these tear patterns is most useful for anatomical restoration during repair. Crescent tears have good medial to lateral mobility and are amenable to a double row repair. Longitudinal tears (L- and reverse L-shaped tears; U-shaped tears) have greater mobility in one plane and typically require margin convergence to achieve complete repair.

The Fosbury flop tear is a newly-described lesion, which occurs from a full-thickness tear that has flipped upon itself and adhered medially. Radiographically, this lesion showed a thicker-than-normal tendon stump on the bursal side of the retracted supraspinatus tendon in a superomedial orientation (Lädermann et al., 2015).

Furthermore, Ellman and Gartsman classification is increasingly used by orthopedists. The authors distinguish six types of muscle supraspinatus tears. In addition to the crescent, L-shaped and reverse, authors distinguish massive and trapezoidal tears. Moreover, partial tears may be intra-articular, intra-tendinous and bursal. The Ellman classification of partial tears is used in clinical practice (Cicak et al., 2015).

Disruption of the lateral tendon stump can be followed by adhesion under the acromion, the coracoid process or the coraco-acromial arch (Romeo et al., 1998).

Studying the anatomical differences on the cadavers is essential for understanding and explaining related disorders in medical and surgical practice (Hegazy et al., 2019).

Some researchers note that supraspinatus injuries are not always typical. We have a division of tears according to the thickness of the tear, the type of tear (Crescent, Reverse, L-shaped, Trapezoidal and Massive tear), and whether a partial rupture can be intra-articular, intra-tendinous, or bursal (Cicak et al., 2015), therefore our goal is to show another, new type of supraspinatus tear.

CASE REPORT

During the investigation of the cadaver, of a 68-year-old man, preserved in 5% formalin solution, in the Department of Human Anatomy, at the Medical University of Silesia we found an unusual supraspinatus muscle tear. Tendon of the muscle was divided into two parts: anterior and posterior. The anterior part of the muscle was separated from the common tendon of the supraspinatus muscle, slipped off downwards anteriorly to the greater tubercle revealing the humerus head. Half of the fibers of the anterior part of this muscle found their attachment on the greater tubercle and the other half to the lesser tubercle. It follows that an additional supraspinatus attachment had developed on the lesser tubercle. The posterior part of the supraspinatus muscle also was slipped off but in posterior direction. The posterior part attached only to the greater tubercle.

During the examination, we did not find major changes of the remaining rotator cuff muscles and tendons. Moreover, no changes caused by the surgeries of the above-mentioned joint, chest and cervical spine were detected. On the opposite side of the body, we did not detect any pathological changes related to the tearing, rupture, damage and post-surgery condition of tendons and muscles of the rotator cuff.

Also, after many years using that pathological joint, the humerus head made a hole in the middle part of the deltoid muscle. Moreover, the body produced a bursa that lines the inner layer of the shoulder skin probably to protect from abrasion. The above-mentioned bursa was connected with the subacromial bursa, which was then fused with the skin.

Fig. 1.- Lateral view of the humeral joint. Anterior part of deltoid muscle (1), Posterior part of deltoid muscle (2), Humeral head (3), Tendon of supraspinatus muscle “posterior part” (4), Tendon of supraspinatus muscle “anterior part” (5).

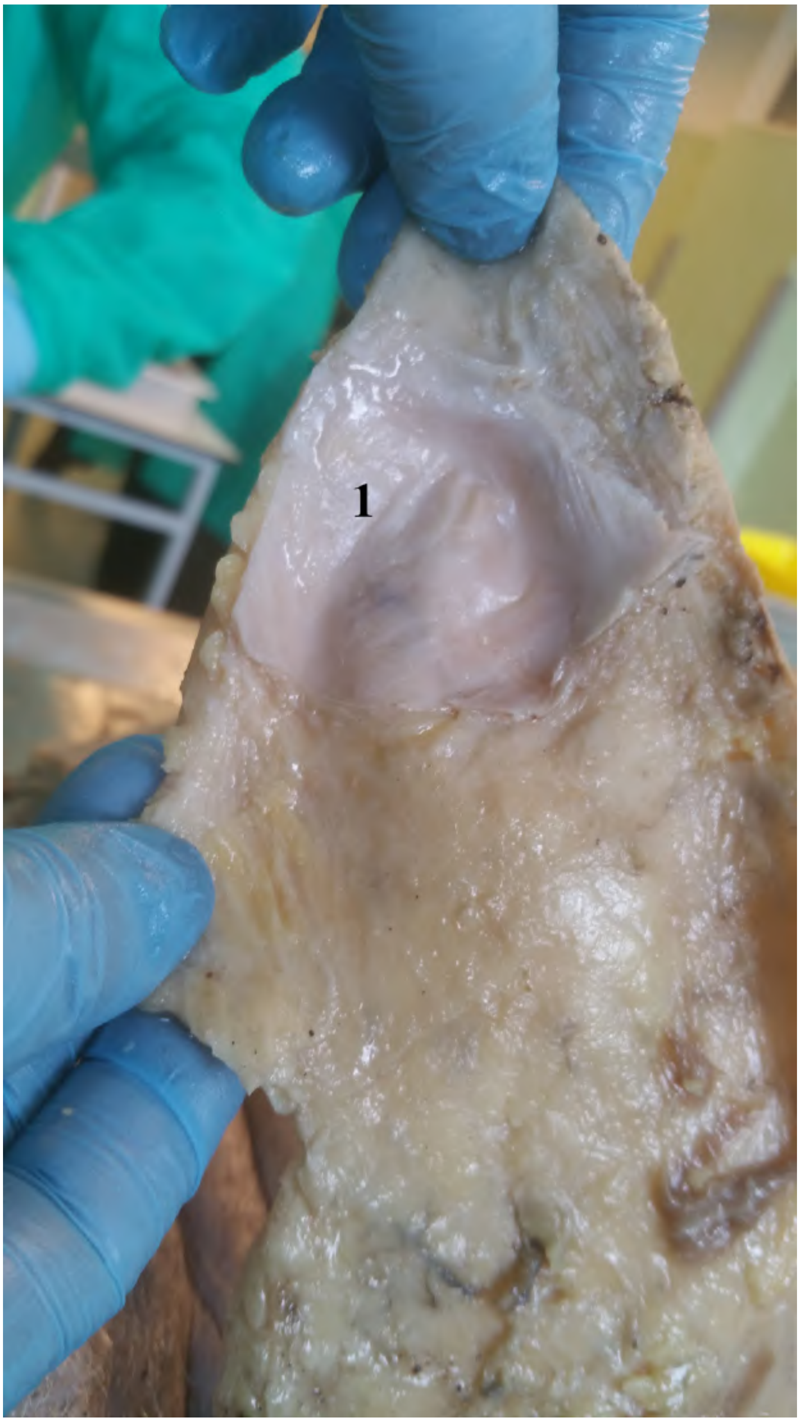

Fig. 2.- Inner layer of the skin. Bursa between the skin and humerus head (1).

Using the goniometer, we also examined the range of passive motion in the shoulder joints. Range of passive motion of the affected shoulder joint was significantly less than on the other, "healthy" side. Flexion of the affected joint was 35°, abduction 25° and in the second joint observed range of flexion 60°, abduction 45°. In addition, extensive damage to the cartilage of the humeral head was observed only on the right upper limb. No pathological or degenerative changes were observed in the acromioclavicular joint.

COMMENTS

Comparing the literature, a similar case took place in Kolts's cadaver research. In one of the rotator cuffs tears the author studied, the supraspinatus muscle tendon was divided into two parts: anterior and posterior, which also slipped off downwards to the greater tubercle revealing the humerus head. The posterior part of the supraspinatus muscle was attached to the major tubercle. The anterior part of the supraspinatus

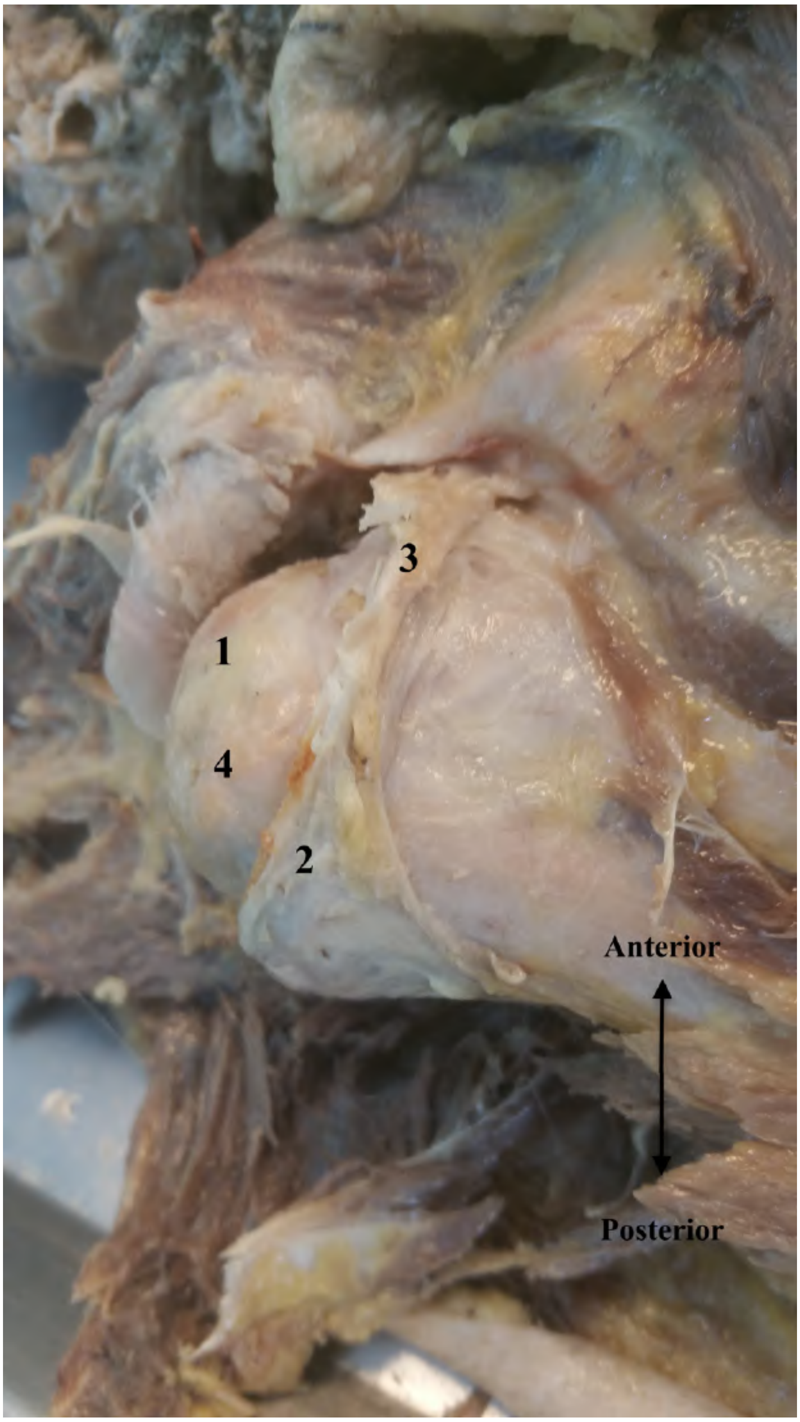

Fig. 3.- Lateral view of the humeral joint. Humerus head (1), Tendon of supraspinatus muscle "posterior part" (2), Tendon of supraspinatus muscle "anterior part", which runs perpendicular to the intertubercular groove (3), Greater tubercle of the humerus (4).

muscle was attached to the lesser tubercle and was named by the authors "accessory part". The authors claim that the fact of an accessory tendon might be of functional and clinical importance, because that tendon which has insertion on the lesser tubercle is weaker than the "common" tendon (Kolts et al., 1992).

In our case, an accessory tendon also can be distinguished, but the anterior tendon part attaches to the greater and lesser tubercles and the posterior part attaches only to the greater tubercle. Apart from the insertion to the greater and lesser tubercles, there is also a connection between two newly formed tendons that runs perpendicular to the intertubercular groove.

The mechanism development and insertion of an additional tendon can create new compensatory movement patterns and role for the glenohumeral joint, because ruptures occur in the part of the tendon that inserts on the greater tubercle. In addition, in the fixing of the humerus head and abduction, the supraspinatus muscle can also act as an internal rotator.

The above lesion change does not have the characteristics that could suggest that it had occurred in the embryonic life, due to the fact that the edges of the lesion were scarred and accompanied by intense degenerative changes within the articular cartilage.

Research of the anatomical variations are clinically very important to reduce complications during surgeries, develop new methods of arthroscopic reconstruction of rotator cuff tears and reduce potential risk of injury during physiotherapy.

In addition, this study is important for imaging diagnosticians' analysis. Ultrasound examination completes the patient's clinical findings. It provides a high probability of finding a tendon tear and determining its size (Ziegler et al., 2004). Therefore, many clinicians are committed to this method of diagnosing rotator cuff tears. However, tendon echogenicity is not a fully reliable sign of a complete rupture of the cuff. MRI indicates a high level of reliability in diagnosing the rotator cuff tear. MRI allows free access to the location and indicates the size of the tear and the muscle condition. In contrast to the ultrasound, MRI shows the size of the tendon retraction and the condition of the muscle in relation to the fatty degeneration level (Cicak et al., 2015).

Our study is also interesting because it shows how passive range of motion is maintained despite massive muscle damage and massive damage to the cartilage structures. The change also shows the role of the synovial bursa in the pathophysiology process, as it separates the conflicting structures—in our case a lump larger than the skin.

ACKNOWLEDGEMENTS

The authors wish to thank the Medical University of Silesia in Katowice for sharing cadavers from a voluntary donation program for research.

REFERENCES

BARTH JR, BURKHART SS, DE BEER JF (2006) The bear-hug test: a new and sensitive test for diagnosing a subscapularis tear. *Arthroscopy,* 22: 1076-1084.

BENSON RT, MCDONNELL SM, KNOWLES HJ, REES JL CARR AJ, HULLEY PA (2010) Tendinopathy and tears of the rotator cuff are associated with hypoxia and apoptosis. *J Bone Joint Surg Br*, 92: 448-453.

BOCHENEK A, REICHER M (1990) Anatomia człowieka, pp 785-786.

BURKE WS, VANGSNESS CT, POWERS CM (2002) Strengthening the supraspinatus: A clinical and biomechanical review. *Clin Orthop Relat Res*, 402: 292-298.

CICAK N, KLOBUCAR H, NENAD M (2015) Rotator cuff injury. *Medicina Fluminensis*, 51(1): 7-17.

DAVIDSON J, BURKHART SS (2010) The geometric classification of rotator cuff tears: a system linking tear pattern to treatment and prognosis. *Arthroscopy*, 26: 417-424.

HEGAZY AA (2019) Human anatomy: an inlet of medicine and surgery. *IJHA*, 1(4): 1-1.

HUEGEL J, WILLIAMS A, SOKOLOWSKY J (2015) Rotator cuff biology and biomechanics: a review of normal and pathological conditions. Orthopaedic Research Laboratory, Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA 19104, USA.

KOLTS I (1992) A note on the anatomy of the supraspinatus muscle. *Arch Orthop Trauma Surg*, 111: 247-249.

LÄDERMANN A, DENARD PJ, KOLO FC (2015) A new tear pattern of the rotator cuff and its treatment: Fosbury flop tears. *Int J Shoulder Surg*, 9: 9-12.

MEHTA S, GIMBEL JA, SOSLOWSKY LJ (2003) Etiologic and pathogenetic factors for rotator cuff tendinopathy. *Clin Sports Med*, 22: 791-812.

NEER CS 2^{nd} (2005) Anterior acromioplasty for the chronic impingement syndrome in the shoulder. *J Bone Joint Surg Am*, 87(6): 1399-1399.

ROMEO AA, LOUTZENHEISER T, RHEE YG (1998) The humeroscapular motion interface. *Clin Orthop Relat Res*, 350: 120-127.

ZIEGLER, DEAN W (2004) The use of in-office, orthopaedist-performed ultrasound of the shoulder to evaluate and manage rotator cuff disorders. *J Shoulder Elbow Surg*, 13: 291-297.