

The Challenges of Arthroscopic Diagnosis of Subscapularis Tears

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Visualisation of subscapularis lesions is difficult during open surgery. Introduction of arthroscopic procedures for rotator cuff surgery improved the diagnosis of subscapularis tears, but it still can be more challenging than for other rotator cuff tendon tears. The SFA classification of subscapularis tears is reproducible and correlates well with the arthroscopic findings. The arthroscopic diagnosis of subscapularis tear is made easier by: shoulder internal rotation, biceps tenodesis, dissection of the rotator interval, recognition of the sentinel and comma signs.

Keywords: Subscapularis tears, subscapularis arthroscopic, subscapularis diagnosis

There are significant differences between the anatomical characteristics of the subscapularis tendon compared to the supraspinatus and the infraspinatus tendons [1]. From an anatomical point of view the subscapularis can be divided into several parts.

The *uppermost part* forms the floor of the most proximal part of the bicipital pulley groove. It attaches to the upper margin of the lesser tuberosity, sends a thin tendinous slip to the fovea capitis of the humerus [2] and has connexions with fibres of the supraspinatus tendon and coracohumeral ligament [3, 4].

The *superior and middle parts* have *deep fibres* which insert on the lesser tuberosity and the floor of the bicipital groove and *superficial fibres* traversing over the biceps to insert on the greater tuberosity [5]. The *inferior part* consists of muscle fibres attaching directly to the distal lesser tuberosity on a narrow vertical footprint [1].

Most of the lesions begin at the superior part of the subscapularis tendon. These lesions, associated with supraspinatus tendon tears, are difficult to visualize during open surgery. The subscapularis tears with an intact biceps pulley or rotator interval, the so-called *hidden lesions*, can be diagnosed in open surgery only after the opening of the rotator interval [6].

The introduction of arthroscopic procedures for rotator cuff surgery improved the diagnosis of subscapularis tears, especially for the more subtle lesions like longitudinal tears of the superior part and partial-thickness transverse tears [7, 8].

The arthroscopic diagnosis can be more challenging than for other rotator cuff tendons tears and the complete visualization of the *hidden lesions* of the subscapularis tears may require removal of the rotator interval and medial pulley [9]. New advances in the field, like the use of a computer navigation system and haptic robotic shoulder arthroscopy could further improve the diagnosis and treatment of subscapularis tears [10-13].

The long head of the biceps tendon is usually unstable and pathologic in cases of subscapularis tendon tears associated with lesions of the superior glenohumeral ligament/coracohumeral ligament complex [14].

Our primary objective was to evaluate if the subscapularis tears classification of the French Society of Arthroscopy (SFA) [1] is reproducible, correlates well with the patterns of tears encountered in our clinical practice and allows for comparison of the epidemiological and

outcome data. The secondary objective was to define methods of improving the arthroscopic diagnosis of subscapularis tears.

Experimental part

The preoperative evaluation included a clinical examination, of great importance being the lift-off [15], the belly press [16] and the bear hug [17] tests. Conventional shoulder radiographies, arthro-CT and MRI scans, stored in the local PACS, were also part of the preoperative evaluation [18].

All shoulder arthroscopies were performed in the beach-chair position, with general anaesthesia and inter-scalene nerve block. Relevant images and videos of the subscapularis tears were recorded, all patients provided informed consent.

Each identified subscapularis tear was categorized using the SFA classification. Four types were described in the SFA arthroscopic classification [1] of subscapularis tears:

-Type 1-a normal anterior sling wall with partial subscapularis tendon detachment at the articular side of the superior tendon

-Type 2 - a combined partial subscapularis separation from the lesser tuberosity and a partial tear in the anterior sling wall. As the size increases, a delaminated tear of the subscapularis tendon (as described for the infraspinatus tendon) can be found

-Type 3 - a complete subscapularis tendon detachment and a complete tear in the anterior sling wall, only the most superficial fibres remaining continuous with the sling

-Type 4 - a complete detachment of the subscapularis tendon from the humerus by a full-thickness tear, leaving a free lateral edge, associated with the *comma* sign.

Results and discussions

In the type 1 SFA we included all cases in which we found a partial detachment of the subscapularis fibres from the lesser humeral tuberosity, without lesions of the bicipital pulley. This type of lesion can be diagnosed on the preoperative imagery (fig.1) and confirmed arthroscopically (fig. 2)

A combined partial subscapularis separation from the lesser tuberosity associated with a partial lesion of the anterior sling wall and an intact superior glenohumeral ligament was classified as type 2 SFA. The lesion was

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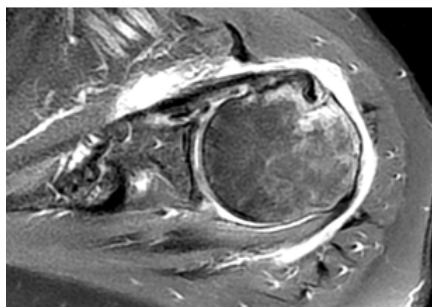


Fig. 1 SFA type 1

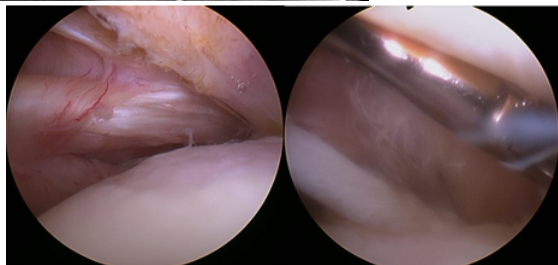


Fig. 2 SFA type 2

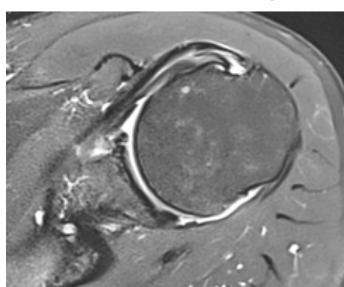


Fig. 3 SFA type 2

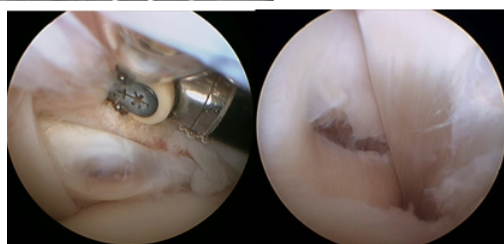


Fig. 4 SFA type 2

identified on the preoperative imagery (fig. 3) and arthroscopically (fig. 4).

The cases with a complete subscapularis detachment from the lesser tuberosity and a complete tear in the anterior sling wall, with only the most superficial fibres of the subscapularis remaining continuous with the sling were included in the type 3 SFA. The tear can be visualized by imagery (fig. 5) and direct arthroscopic visualization (fig. 6).

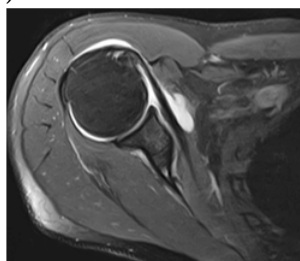


Fig. 5 SFA type 3



Fig. 6 SFA type 3

We classified as type 4 SFA the complete detachment of the subscapularis, leaving a free lateral edge and associated with the *comma* sign. There was a good correlation between the preoperative imagery (fig. 7) and intraoperative findings (fig. 8)

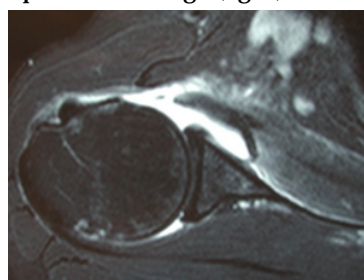


Fig. 7 SFA type 4



Fig. 8 SFA type 4

Lo and Burkhart [19] described the *comma* sign in 2003. It was at first considered to be formed by a portion of the superior glenohumeral ligament / coracohumeral ligament complex.

Visona et al. [20] in an anatomical investigation found that it consists of fibres originating from the superior glenohumeral ligament / coracohumeral ligament complex and from supraspinatus which insert on the lateral aspect of the subscapularis. This comma sign is clearly visible in cases with a significant retraction of the subscapularis tendon (fig. 9). The arthroscopic identification of this sign is very important in restoring the supraspinatus function in tears of the antero-superior cuff. The arthroscopic diagnosis of subscapularis tears is facilitated by the internal rotation of the shoulder.



Fig. 9 Comma sign

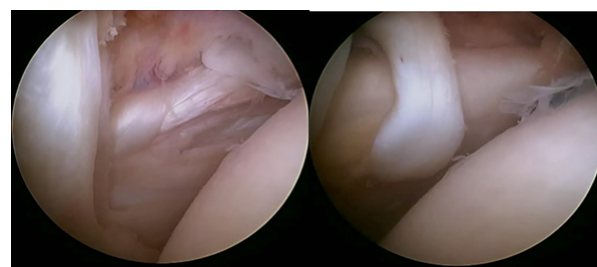


Fig. 10 MGHL test

The biceps tenodesis (which we perform systematically) allows for a better exposure of the subscapularis tears. Lesions of the biceps tendon (scuffing, abrasion or partial tear of its anterior portion) should alert us of the possible presence of an associated subscapularis tear. This was described by Sahu [21] as the sentinel sign.

To check the accuracy of the subscapularis reduction, it is useful to look for the middle glenohumeral ligament (MGHL). The MGHL is not visible with a retracted subscapularis and usually becomes visible after a correct reduction (fig. 10). This was described by the senior author (LNJ) as the MGHL test. In type 3 SFA, the MGHL test can be positive due to a retraction of the articular part of the subscapularis tendon, although the horizontal superior tendon is still being visible. This situation can be misleading. When we have a clinical suspicion of a hidden subscapular lesion, the arthroscopic dissection of the rotator interval and the medial pulley of the biceps is needed to visualize it [9].

The Lafosse classification [8, 22] is widely used to categorize subscapularis tears. It is a generally accepted classification, but it has been shown there is still place for improvement regarding interobserver agreement [23]. The tears are described in the superior to inferior direction and the bicipital sling lesions and the thickness of the lesions are not taken into account. The SFA classification evolved from the Lafosse classification, and, in our experience, we found a better correlation of the arthroscopic findings with the SFA classification.

Conclusions

The arthroscopic evaluation of the subscapularis tendon tears allows us to diagnose and treat otherwise *hidden* lesion and to appreciate the true extent of a subscapularis tear.

The SFA classification can be successfully used to categorize arthroscopically the subscapularis tears. In our experience, we managed to unambiguously organize each encountered subscapularis in one of the four types of the SFA classification. This classification facilitates communication between surgeons, making it easier to compare treatment and outcome data.

The arthroscopic diagnosis of subscapularis tear is facilitated by: internal rotation, observing a medial fraying of the biceps tendon (*sentinel sign*), biceps tenodesis, dissection of the rotator interval and medial pulley and the recognition of the *comma* sign.

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