Technical Note

Arthroscopic single portal – single row knotless repair of subscapularis tendon tear: Technical note

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ABSTRACT

The subscapularis (SSc) is the most powerful muscle of the rotator cuff. Its role in shoulder stability and shoulder motion is well studied and due to functional and frequent association with concomitant other lesions, the repair of the SSc tendon is always desirable to restore force and stability to the shoulder.

• **Current techniques:** Management of this tendon lesions could be approached both with an open or arthroscopic technique with good results. The arthroscopic repair is minimally invasive and may allow a quicker recovery with less postoperative pain than an open approach. Problems with arthroscopic procedure were associated with lack of working space and to less time dedicated to other lesions before fluid extravasion.

• **New techniques:** the development of surgical techniques and new anchor designs tried to facilitate repair of SSc tear. The advent of knotless anchors permits fixing the tendon with reduced working space and with less surgical time. We present a surgical technique for SSc repair using a single anterior superior portal and a knotless self-punching anchor fixation (SPAK technique).

Introduction

Patients who undergo arthroscopic rotator cuff repair commonly also present a subscapularis (SSc) torn tendon and its prevalence ranges from 8% to 52% [1]. Due to functional impairment and frequent association with concomitant other lesions, repair of the SSc tendon is always desirable to restore force and stability to the shoulder, allowing a better

postero-superior cuff repair with a decrease tension on supraspinatus tendon repair [2]. Management of this tendon lesion could be approached both with an open or arthroscopic technique with good results [3]. Historically, limitation of visualization and restricted working space were considered the boundary of arthroscopic repair of SSc. However, progresses in imaging quality and surgical techniques improved its arthroscopic management. In fact, there are now a variety of arthroscopic techniques for SSc tendon repair described with good/excellent results [4]. The arthroscopic repair is minimally invasive and may allow a quicker recovery with less postoperative pain than an open approach. Furthermore, in the past several years, repair of SSc tears has been deemed to be a challenging procedure requiring careful surgical steps: evaluation of the tear, mobilization of the tendon, preparation of footprint and fixation to the lesser tuberosity. For a correct evaluation of the rotator cuff tear, the ISAKOS grading system [5] appears complete, comprehensive and user-friendly. It gives information to aid in predicting difficulties during the procedure and determining prognostics. This system takes into account five essentials characteristics with regards to tears: pattern (P), extension (E), fatty atrophy (A), retraction (R), and location (L), conforming the acronym “PEARL” [5]. In addition, there are several classification systems for subscapularis tendon tears from radiological to clinical and arthroscopic. The Lafosse classification [6] differentiates the SSc lesions into five types (Table 1).

Latter surgical steps were simplified with the advent of knotless anchors [7]. We present a surgical technique for SSc repair named SPAK

Abbreviations: SPAK, single portal arthroscopic knotless.

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Table 1
Subscapularis tendon tear classification according to Lafosse.

Type I	Partial-thickness tear of the superior third of the SSc without tendon retraction and complete detachment (undersurface tear of the upper third)
Type II	Complete tear (detachment) of the superior third of the SSc tendon
Type III	Complete tear of the superior two-thirds of the SSc tendon without muscle detachment of the inferior third, thus limiting tendon retraction
Type IV	Complete tear of the SSc with the tendon retracted closer to the glenoid but with the humeral head centered and stage ≤ 3 fatty atrophy in the SSc muscle
Type V	Complete tear of the SSc with tendon retraction and an eccentric positioning of the humeral head or fatty degeneration stage > 3 atrophy

(SSc: subscapularis).

Fig. 1. The patient is in lateral decubitus. Left shoulder. Arthroscopic view. The scope is intrarticular. LHB tendon is flattened, delaminated, and slightly anteriorly subluxated (LHB: long head biceps tendon; HH humeral head).

(single portal arthroscopic knotless) consisting of the use of a single anterior superior portal and a knotless anchor fixation.

Surgical indication

Taking into account the Lafosse classification system (Table 1), the reported technique appears suitable for the first 3 stages of tendon tear (partial detachment). In case of complete tendon detachment (stage IV and V) a sole portal does not permit good visualization and only one anchor appears insufficient in order to restore the foot-print.

Surgical technique

The procedure can be carried out both in beach chair or in lateral decubitus according with surgeon's preference. Sterile field and draping are set on after standard skin disinfection. The arm could be loose or with a holder if beach chair position is chosen. The current SPAK technique (video 1) is demonstrated with the patient positioned in lateral decubitus, stabilized on a bean bag, with a dorsal tilt of 30° with the glenoid surface parallel to the floor as a reference. Once the patient is positioned with the arm in traction, landmarks of the shoulder are identified and marked with a dermographic pen. A standard posterior portal is performed for initial intra-articular visualization. The arthroscope with standard 30° optics is inserted into the intra-articular space. After the diagnostic phase an 18-gauge spinal needle is used to localize the anterior portal within the rotator interval (outside-in-technique), directly centered on the SSc tendon. Portal positioning is essential to ensure instruments can easily access the subscapularis tendon and the two main portal's aspects are: 1) to be tangent to the superior edge of the SSc tendon; 2) to be high enough (i.e. almost perpendicular to the lesser tuberosity) so to correctly insert the anchor (in the right place and with the right inclination) (Video 1: 04:10 - 04:35). A canula may be used through the anterior portal for suture management and to facilitate the maneuvers, even if it may reduce the working space. The state of the biceps's tendon is evaluated with a hook probe. Usually, in the presence of a SSc tear the LHB appears involved and anteriorly subluxated (Fig. 1). The presence of a pathological LHB tendon can cause pain and discomfort to the healing of the SSc repair [7], and for this reason it is recommended to choose the best treatment among the different options summarized in Fig. 2 before starting to repair the SSc. Four different consecutive steps may be identified.

- 1) **Mobilization of SSc and soft tissue release:** The first step consists of the mobilization of the tendon that may appear retracted and with adhesions (especially Lafosse type III tear or more requires an accurate tendon mobilization). The release has to be performed on the 3 sides of the tendon (anterior, superior and posterior) using different tools such as radio frequency probe or a motorized shaver. To avoid the risk of musculo-cutaneous nerve damage for the anterior release, a blunt probe may be used. If necessary, the middle gleno-humeral ligament may be also incised. The release may be considered sufficient only if the tendon (with a grasper) may reach the lesser tuberosity without overtension. To enhance mobilization and visualization, the rotator cuff interval may be surgically opened and coracoid-plasty

Fig. 2. Treatment options in case of pathological LHB. (LHB: long head biceps tendon; RC: rotator cuff; MRCT: massive rotator cuff tear; SCR: superior capsular reconstruction).

may be performed (these accessory steps usually are not necessary in presence of a Lafosse type I, II and III tears).

- 2) **Bone bed preparation:** The natural SSc insertion is located on the lesser tuberosity medially to the bicipital groove. The bone bed of the lesser tuberosity is prepared with a shaver and motorized burr to obtain a wide surface decortication of the footprint providing maximum spongy bone. It is recommended to prepare the medial part of its insertion (close to the cartilage margin) until bleeding and leave the lateral one intact. This aspect is crucial to avoid an excessive weakening of the humeral head and avoid the anchor pullout (considering that anchor will be inserted in the lateral part).
- 3) **Tendon preparation:** A suture tape (XBraid TT—1.2 mm, Braided Polyethylene, Stryker, USA) is loaded on a suture passer (Champion Passer, Stryker, USA) and the most medial and lower part of the tendon is caught passing the tape from anterior to posterior, to avoid damage from suture passer needle at the anterior neurovascular structures. This suture passer allows for passing and retrieving of sutures simultaneously so as to simplify and speed up these arthroscopic steps (Fig. 3). The same end is re-loaded on the suture passer. Before passing the same suture through the tendon for the second time, the assistant will pull up a traction on both ends so to catch as much medial tissue as possible (this trick is particularly useful in the presence of a larger retracted tear). This results in an armed SSc tendon with a loop made of tape (the same end of the suture passing through the tendon twice at different heights) (Fig. 4).
- 4) **Tendon fixation:** The two ends of the suture tape are loaded into the eyelet of a knotless anchor (ReelX STT 4.5 mm—Stryker) that will be used to fix the tendon on lesser tuberosity (Fig. 5). The anchor is placed in the lateral part of native SSc insertion directed from proximal to distal and anterior to posterior. Tension of the repaired tendon is checked. In case of unsatisfactory results, additional tension could be added using the uncut ends of the tape making a revo knot passing just medial to the loop, so to place force on the suture and not on the tendon. The loose ends of the tape are then cut. Once the SSc has been repaired, surgery may continue with the repair of supraspinatus/infraspinatus tear (if concomitant). Furthermore, with the use of the same anchor, it is possible to simultaneously perform LHB tenodesis. In this case, LHB proximal tenotomy is achieved after making a loop made of tape around bicep tendon. Finally, the tails of the suture tape are loaded in the eyelet of the same knotless anchor employed to perform SSc repair.

Post-operative rehabilitation

Postoperatively, the arm is placed in an abduction pillow at 15°, which is to be maintained for 30 days. Passive shoulder mobilization and active hand, wrist and elbow exercises start from the first day after surgery. Immediate post-op mobilization aims to prevent articular stiffness. External rotation is limited to 0° for the first 4 weeks. Active-assisted shoulder exercises are allowed from the first month postop, and from the second month strengthening exercises of the deltoid are permitted [8].

Discussion

Many SSc tendon repair techniques, both open and arthroscopic, have been described in the literature [9], and excellent outcomes have been reported [4]. However currently, the SSc tendon repair during arthroscopy is considered a challenging procedure to perform [10].

The most important finding of this article is that during arthroscopy, with the usual 30° arthroscope, using only one anterior portal and one knotless anchor is enough to obtain a valid fixation of the SSc tear. The SPAK technique may potentially have a lot of advantages.

First of all, there is no need to change from the 30° arthroscope, as most of the shoulder surgeons not confident with a 70° arthroscope.

Moreover, the single portal reduces working time and minimizes

Fig. 3. Tendon preparation: step 1. The patient is in a lateral decubitus. Arthroscopic view. Left shoulder. The scope is intrarticular. A suture tape (XBraid TT—1.2 mm, Braided Polyethylene, Stryker, USA) is loaded on a suture passer entering from the anterior portal (A) and the most medial and lower part of the tendon is caught (B) passing the tape from anterior to posterior (C). The suture passer allows for passing and retrieving suture simultaneously (D). (L: labrum; G: glenoid; HH: humeral head; T: subscapularis tendon).

Fig. 4. Tendon preparation: step 2. The patient is in a lateral decubitus. Arthroscopic view. Left shoulder. The scope is intrarticular. The same end of the tape is re-loaded on the suture passer (A). A traction on both ends of the tape is applied so to catch much medial tissue as possible (B), before passing (C) and retrieve (D) for the second time the suture yet passed through the tendon. The SSc tendon is so armed with a loop made of tape (E). (L: labrum; G: glenoid; HH: humeral head; T: subscapularis tendon).

issues with fluid extravasation. With a second anterior portal, an additional capsulectomy is required with increased subcoracoid swelling. The subcoracoid space is sensitive to soft-tissue oedema and minimizing fluid extravasation will expand working space for treatment of other tears/pathology (i.e. concomitant rotator cuff tendon tears).

Therefore, this technique seems to be quick and effective for SSc repair avoiding wasting time while the surgeon works in the subacromial space.

For a better visualization and for a major working space, the use of a canula is not recommended. Not performing coracoplasty is also not advised, in accordance with some authors, affirming that concomitant coracoplasty may not be imperative during arthroscopic subscapularis full-thickness tears [11].

There is a great interconnection between the SSc and the LHB. Fibers from the SSc form a covering around the LHB at the proximal end of the groove. In most cases, when there is a tear of SSc tendon, the bicep's pulley is also been damaged along with the LHB tendon subluxated medially [7]. It is advisable to always to treat it to avoid risk of persistent pain and SSc

repair failure. The algorithm of treatment of LHB is reported in Fig. 2.

The use of a knotless and self-punching anchor simplifies and shortens the surgical time involved in fixation, avoiding additional passages of the sutures from different portals.

Another advantage of this technique is the use of tape. It permits better pull-through strength characteristics, compared to suture wires in a rotator cuff biomechanical model [12]. Tape also permits only a few passages through the tendon, maintaining a good tightness.

One primary limitation of the SPAK technique is that it consists of a single-row repair.

In very retracted or extended tears, a double row repair might be useful [4], but some authors found no significant difference in shoulder outcome scores, range of motion, and re-tear rates between single and double-row SSc repair at 2-years follow-up [13]. Double-row repairs require an accessory portal and passages that can extend surgical time [14]. The SPAK technique overcomes the problem of retraction using the trick of the assistant's traction on both ends of the tape, before the second passage through the tendon.

Fig. 5. Tendon fixation: The patient is in lateral decubitus. External view. The two ends of the suture tape are loaded into the eyelet of a knotless PEEK anchor (ReelX STT 4.5 mm—Stryker) (A) that will be used to fix the tendon on lesser tuberosity entering from the same anterior portal (B). Arthroscopic view. Left shoulder. The scope is intrarticular. This anchor is self-puncturing (C) and, once into the joint is placed in the lateral part of native SSc insertion directed from proximal to distal and anterior to posterior (D). (HH: humeral head; T: subscapularis tendon; A: anchor).

Another limitation of single-row repair could be the medialization of SSc tendon insertion at the lesser tuberosity but previous studies have confirmed that a medialization of footprint does not compromise clinical outcomes [15].

In conclusion, the SPAK technique may be recommended for the treatment of a Lafosse stage I, II and III tear, presenting some limitations in case of complete tendon detachment (stage IV and V according to Lafosse).

Ethical approval

Not required.

Informed consent statement (for the video)

Patient was not required to give informed consent to the video because were used anonymous clinical data, but agreed to treatment by written consent.

All medical staff visible in the video is not recognisable (not required a permission), apart from Claudio Chillemi (first surgeon) who gave his written permission.

The permission to reprint the Stryker logos visible in the video was obtained.

Declaration of competing interest

None declared.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jisako.2022.01.002>.

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