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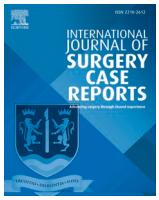

Case report

# A case report of re-implanting a neglected avulsion of supraspinatus tendon by arthroscopic and open surgeries

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ABSTRACT

*Introduction:* Rotator cuff constitutes a mechanical arm and an important stabilizing factor for the shoulder joint, and the supraspinatus muscle is the initiator of the movement of arm in the abduction direction. Rotator cuff injuries constitute an important part of the shoulder pain, and many cases are managed conservatively, nevertheless, open or arthroscopic surgery remains a must in many cases.

*Case report:* We present the case of a patient in the sixth decade of life who complained of absence of abduction movement in his right shoulder three months ago after he lifted a heavy object. The clinical examination showed a positive sign of drop arm and other clinical signs indicating absence of supraspinatus muscle function. The MRI also showed a full-thickness tear of the supraspinatus tendon and its retraction away from its original inserting point on the greater tuberosity of the humerus. The case was managed by re-implanting the ruptured tendon by combining arthroscopic and open surgeries and using two anchors with slipable sutures, adopting the principles of duplicated knots and multiple transverse entry through the tendon to get a firm fulcrum. The results were clearly good after rehabilitation with a wide and powerful ROM (Range of Motion).

*Discussion:* Many cases of RCT (Rotator Cuff Tears) are concretively managed by using corticosteroids injections into the subacromial space with results of significant improvement in symptoms, and arthroscopic surgery is of increasing importance in preventing the development of small partial or full thickness tears and in reconnecting complete or avulsion tears early. The current case is characterized by a clear contraction of the completely avulsed tendon with severe adhesions due to neglection of the case for several months, which made the possibilities of arthroscopic surgeries limited only by acromioplasty, loosening some adhesions and preparation of the footprint, as well as making open surgery mandatory to give a wide area for doubling the suturing layers and then re-implanting the avulsed tendon into its original anchor.

*Conclusion:* Neglect and delay in managing full-thickness tears in the supraspinatus tendon are the important reasons for the occurrence of adhesions and fibrosis, which in turn hinder the process of re-implanting the ruptured tendon at its original anchor through arthroscopic surgery, so that open surgery becomes the mandatory solution. It is necessary to use anchors with slipable threads and to focus on doubling the suturing layers with repeatedly entering through the muscle tendon to reduce it to the footprint firmly and strongly by tightening the slipable threads through the anchors.

## 1. Introduction

The glenohumeral joint is a ball and socket joint and comprises a larger, round humeral head and a shallow glenoid cavity. It is highly mobile and thus, needs structures to stabilize it. This stabilization is provided collectively by the rotator cuff as a dynamic stabilizer, and capsule, labrum complex, and glenohumeral ligaments as static stabilizers. The cuff gives strength to the capsule of the shoulder all around the joint except inferiorly. This explains why dislocations of the humerus most commonly occur in a downward direction [1]. The rotator cuff includes the following muscles: Subscapularis, Infraspinatus, Supraspinatus and Teres Minor [2].

The supraspinatus muscle originates from the supraspinous fossa of the scapula with its tendon inserting onto the superior and middle facets of the greater tuberosity, it forms the largest component of the posterior wall of the axilla. It prevents the anterior dislocation of the humerus during abduction and medially rotates the humerus. A large bursa separates the muscle from the neck of the scapula [3]. Infraspinatus and

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teres minor originate from the infraspinous fossa with their tendons inserting onto the middle and inferior facets of the greater tuberosity. The subscapularis muscle originates from the subscapular fossa, with its tendon inserting onto the lesser tuberosity. The rotator cuff tendons interdigitate to form a continuous structure near their insertions onto the proximal humerus [4]. The subscapularis muscle has the largest tendon footprint of the four cuff muscles, inserting anteriorly along the medial aspect of the bicipital groove to provide internal rotation. The infraspinatus muscle has the second largest tendon, which inserts with its anterior border overlapping the posterior border of the supraspinatus insertion [5], to provide external rotation. The supraspinatus muscle has the third largest tendon footprint, which inserts onto the superior facet of the greater tuberosity of the proximal humerus to abduct the shoulder. Finally, the teres minor muscle has the smallest tendon footprint, inserting directly inferior to infraspinatus, assisting the latter to rotate the humerus externally. The subscapularis and supraspinatus tendons combine to provide a sheath that surrounds the long head of biceps tendon, with a tendon slip from supraspinatus forming the roof of the sheath, and fibers from both tendons converging to form the floor. Furthermore, fibrous structures extending from the coracoid process to the interval between the subscapularis and supraspinatus muscles strengthen this region, known as the coracohumeral ligament [6].

The rotator cuff muscles have an essential role in the stability and function of the GHJ (Gleno-Humeral Joint). Force couples occur when two opposing muscle groups create a movement around a fulcrum [5]. The rotator cuff creates a force couple around the GHJ with coordinated activation and inactivation of agonist and antagonist muscles, working synergistically to contain the otherwise intrinsically unstable GHJ and prevent proximal migration of the humerus. The deltoid and supraspinatus act as a force couple in the coronal plane, compressing the humeral head to the glenoid in abduction, whereas subscapularis and infraspinatus provide a compressive joint reaction force in the axial plane [7]. This mechanism, where shoulder stability is provided by the rotator cuff muscles, is known as concavity compression [8].

This case report has been reported in line with the SCARE 2020 criteria [9].

## 2. Case report

A 56-year-old male patient presented to the orthopedic clinic in Al-Assad University hospital in Damascus (AUHD), He was a right-handed farmer, and his weight was 98 kg. He walked into the clinic. He was mild smoker and had no family, personal or drug history. His main compliant was disability to abduct the right arm during the last 3 months after lifting a heavy object. He said that the pain started about two years before this accident, as he complained of gradual pain in his right shoulder and the doctors diagnosed impingement syndrome and treated it with two local injections of cortisone in the right joint during the first year, and he got very good results especially after the second injection.

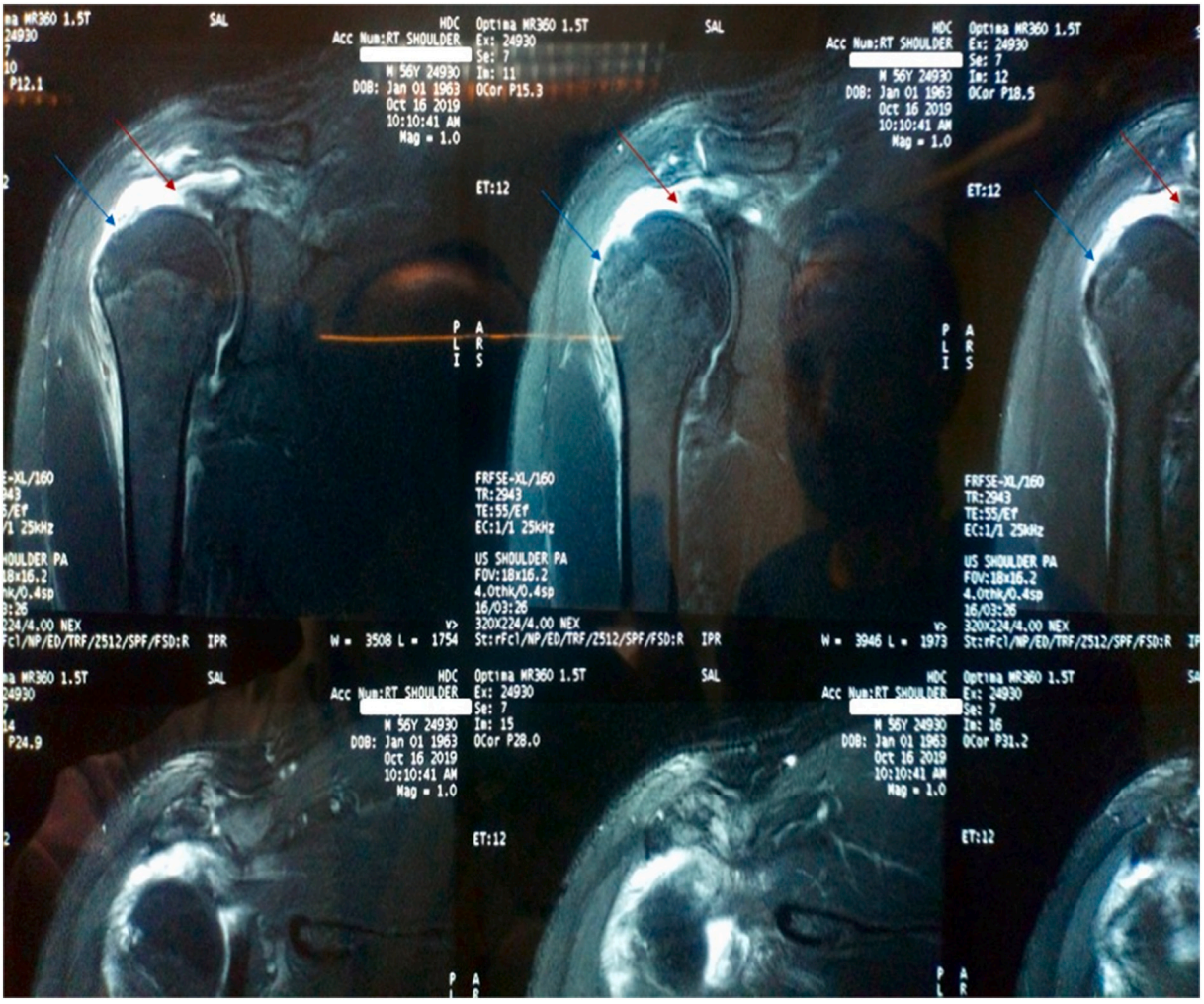


**Fig. 1.** MRI of the Right shoulder shows a clear gap between supra-spinatus tendon (red arrows) and its original inserting point onto the greater tuberosity of the Humerus (blue arrows).

Clinical examination revealed disability to abduct the right arm with clear positive drop arm test and weakness of the right deltoid, there was no tenderness or instability at the right gleno-humeral and Acromio-Clavicular (AC) joints, and the contralateral shoulder had a normal range of motion (ROM) with mild tenderness at the subacromial space.

X-Ray showed that there were no clear fractures or dislocations at the insertion of the supra-spinatus tendon, but the MRI discovered an obvious full thickness tear at the inserting point of the supra-spinatus tendon with a clear gap (about 2 to 3 cm) between the medially pulled tendon and the footprint in the greater tuberosity [Fig. 1].

The surgical treatment was done under general anesthesia in lateral decubitus position, in two stages [Fig. 2A]:

1- The first stage (Arthroscopic surgery): through three portals; posterior, midlateral and anterior the joint was examined, the integrity of the articular structures (such as labrum, long tendon of the biceps, articular cartilages, and capsule) were with normal limits, as well as a full thickness rupture of the supraspinatus muscle tendon on a degenerative ground. The ruptured tendon was severely medially deviated far from its original inserting point onto the greater tuberosity of the humerus [Fig. 2B & C], with signs of scaring and fibrous adhesions between the tendon and the subacromial bursa which, in turn, found fibrotic and retractile. The tendon was released and the adhesions around it were untied by arthroscopic shaver. Several attempts were made to tighten the ruptured tendon towards its original anchor, to no avail, due to the muscle's shrinkage during the past three months, so we decided to move to open surgery to obtain a wider surgical field that allows the possibility of tightening the muscle tendon towards the anchor. And securing a good encounter between them.
2- The second stage (Open surgery): in the same position (left lateral decubitus), and through a lateral longitudinal exposure, the subacromial area was clearly exposed through the deltoid's fibers. The supraspinatus tendon was clearly isolated and pulled laterally towards its original insertion onto the greater tuberosity of the humerus which was previously prepared during arthroscopic phase by using arthroscopic burr. After that, two suitable holes were made in the insertion footprint with an awl and taper, then two (4.5 mm) anchors, with two slipable sutures for each one, were inserted into those holes [Figs. 3 & 4A–C]. One arm of each suture was sequentially sewn to the ruptured tendon by using duplicated modified Kessler's technique, and then the other arm was pulled through the anchor to slide the tendon close to the anchors, and then fixed tightly through duplicated knots for each suture [video No1]. A transverse tunnel was drilled about 1.5 cm distal to the anchors and one end of each suture passed this tunnel to be knotted to the other arm that was sewn proximally into the tendon, so a second layer of sutures and knots supported the previous one. Finally, when the tendon became firmly fixed to its original insertion point, the exposure was closed anatomically.

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Three days after surgery, the patient was discharged from the orthopedic department with the right arm fixed in abduction and external rotation position to be followed up by the department of physiotherapy. The physiotherapy plan started after three weeks by passive and gradual movements, then active movements started to get full Range of Motions (ROM) and full power in the deltoid and other surrounding muscles. The good results were clear after three months of rehabilitation with good active abduction and good functional results in daily works [video No2].

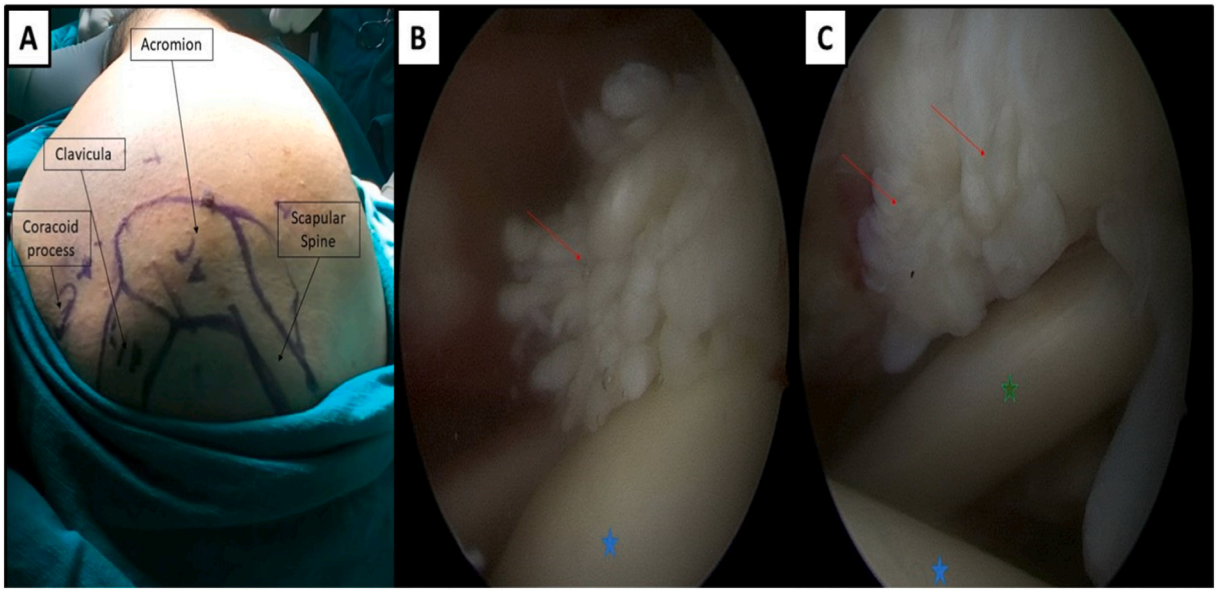


**Fig. 2.** A) decubitus position with superficial anatomy of the Right shoulder. B, C) arthroscopic views show the ruptured supra spinatus tendon that clearly displaced far from its original insertion onto the greater tuberosity of humerus (red arrow), also we can see the cartilaginous surface of the humeral head (blue star) and the long head of the bispace muscle (green star).

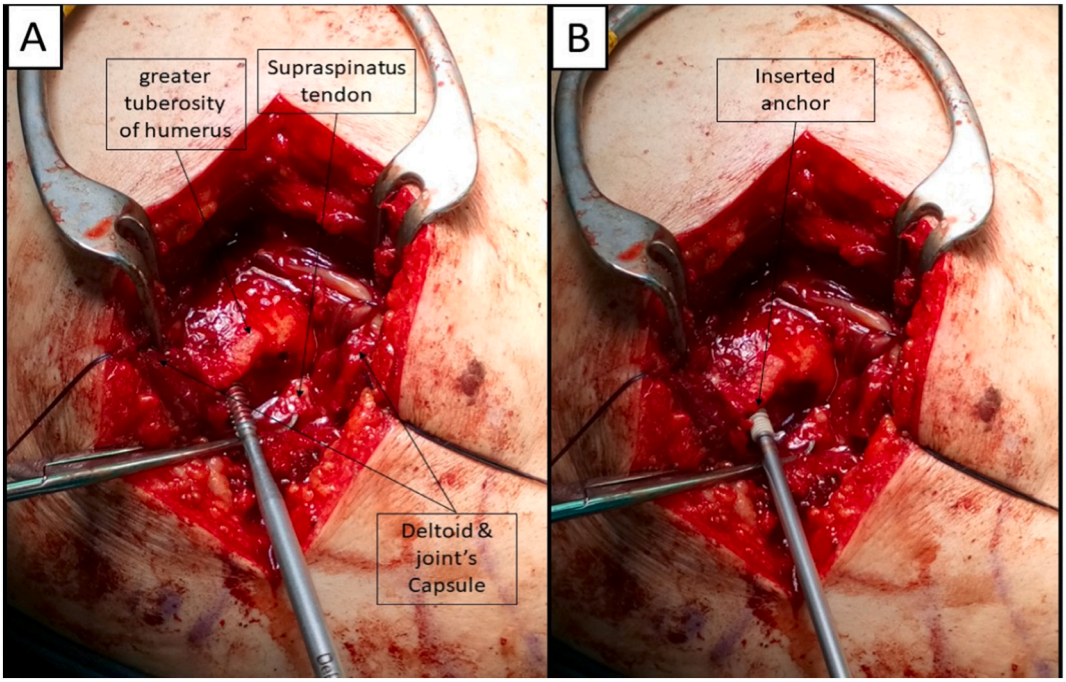


**Fig. 3.** A) Trans-deltoid exposure to the infra-acromial space. We can see the greater tuberosity of humerus, the ruptured end of the supra-spinatus tendon, and the preparation of the two inserting points of anchors. B) The first anchor is inserted into the bony hole.

## 3. Discussion

Once full-thickness cuff tears have developed, they do not heal spontaneously. Moreover, with the progression of tear size, changes in the musculotendinous unit occur, which effect the ability of the tendon to function. Chronic rotator cuff tears can potentially retract and form adhesions that lead to fatty infiltration and atrophy [10]. While many studies support the use of steroid injections, there are also many studies that oppose it. Hart revealed that steroid injection was superior to placebo to improve pain and function only in the short-term [11]. However, Arroll et al. showed that steroid injection can be effective for up to 9 months [12]. According to Bhatia et al., it was also useful for subacromial impingement syndrome, and it was not a causative factor in rotator cuff tear [13]. Another study conducted by Mikolyzk et al. revealed a single dose of steroid weakens both intact and injured rat rotator cuff tendons within 1 week, but this effect transient as the biomechanical properties of the steroid-exposed groups returned to control levels within 3 weeks [14]. In another animal study conducted by Lee et al. found steroid injection may alter the collagen composition and extracellular matrix, thereby interfering with the healing process of rat rotator cuff tear in the early phase after the injection. However, these alterations seem to become normalized after the early inflammatory healing phase [15].

In this case report, we introduced a case of a chronic and neglected complete avulsion rupture of the right supra spinatus tendon in a farmer. The clinical and arthroscopic signs of the chronicity were clear like; deltoid atrophy, fibrotic adhesions, rounded and serrated cutting edges and the sever medially deviated tendon. The patient had a history of two non-echographically guided sub-acromial injections of cortisone about two years before the disability to abduct the right arm, with significantly better pain relief and functional improvement. So, we can guess that the presence of indirect trauma that was caused by heavy object lifting three months prior to surgery, and the long period between the last injection and the time of the tear, may deny the existence of a causal relationship between cortisone injection and the full-thickness tear of the tendon.

To restore the ability to abduct the arm, we applied the technique of duplicating the suturing layers with multiple transverse passage of one arm of each slipable suture, and then pulling the ruptured end of supra spinatus tendon towards previously inserted anchors in the original footprint point, then repeating the same maneuver by drilling a tunnel through the nearby greater tuberosity and making firm knots by using the residual parts of the four sutures. So, if we ask about the indication of open surgery, and why didn't we do that arthroscopically, we can answer by making discussion and comparison among arthroscopic surgery, open surgery, and conservative treatments for RCT (Rotator Cuff Tears) in our case report and some previously published studies.

Surgery is often carried out to prevent tear progression [16]. And arthroscopic rotator cuff repair continues to provide a high success rate of subjective and functional results. With modern techniques being utilized, healing of small to large tears (1 to 4 cm) appears to be improving, with healing rates ranging from 83% to 93% [17,18]. However, successfully repairing massive tears (> 4 cm) remains a challenge despite surgical advances, with reported failure rates ranging from 21% to 91%. Factors known to be associated with enlargement of tears include increasing symptoms, the involvement of 2 or more tendons, and a lesion of the rotator cable [19,20]. The double-row repair technique has been shown to provide a more robust repair, resembling the native footprint compared to the classic single-row suture anchor repair. Although the former technique may be expected to decrease the re-tear rate, short to mid-term clinical results have not demonstrated a consistently clear clinical benefit over single-row repairs [21]. Meier and Meier, in their biomechanical study of thirty fresh frozen cadavers with full-thickness supraspinatus tears, concluded that double-row suture anchor fixation was significantly stronger than single-row repair with a significantly greater fixation strength. They suggested this was because double-row suture anchor fixation consistently reproduced 100% of the original supraspinatus footprint [22]. A more recent biomechanical study of six fresh-frozen cadaveric shoulders compared single-row with triple-loaded suture anchors with suture-bridge double-row repairs for full thickness supraspinatus tears. Superior biomechanical properties were found in the single-row group, with this group exhibiting higher ultimate failure loads (326 N vs 300 N) [23]. A recently published review reported a progression rate of 40% in conservatively treated full-thickness tears after 4 years' observation

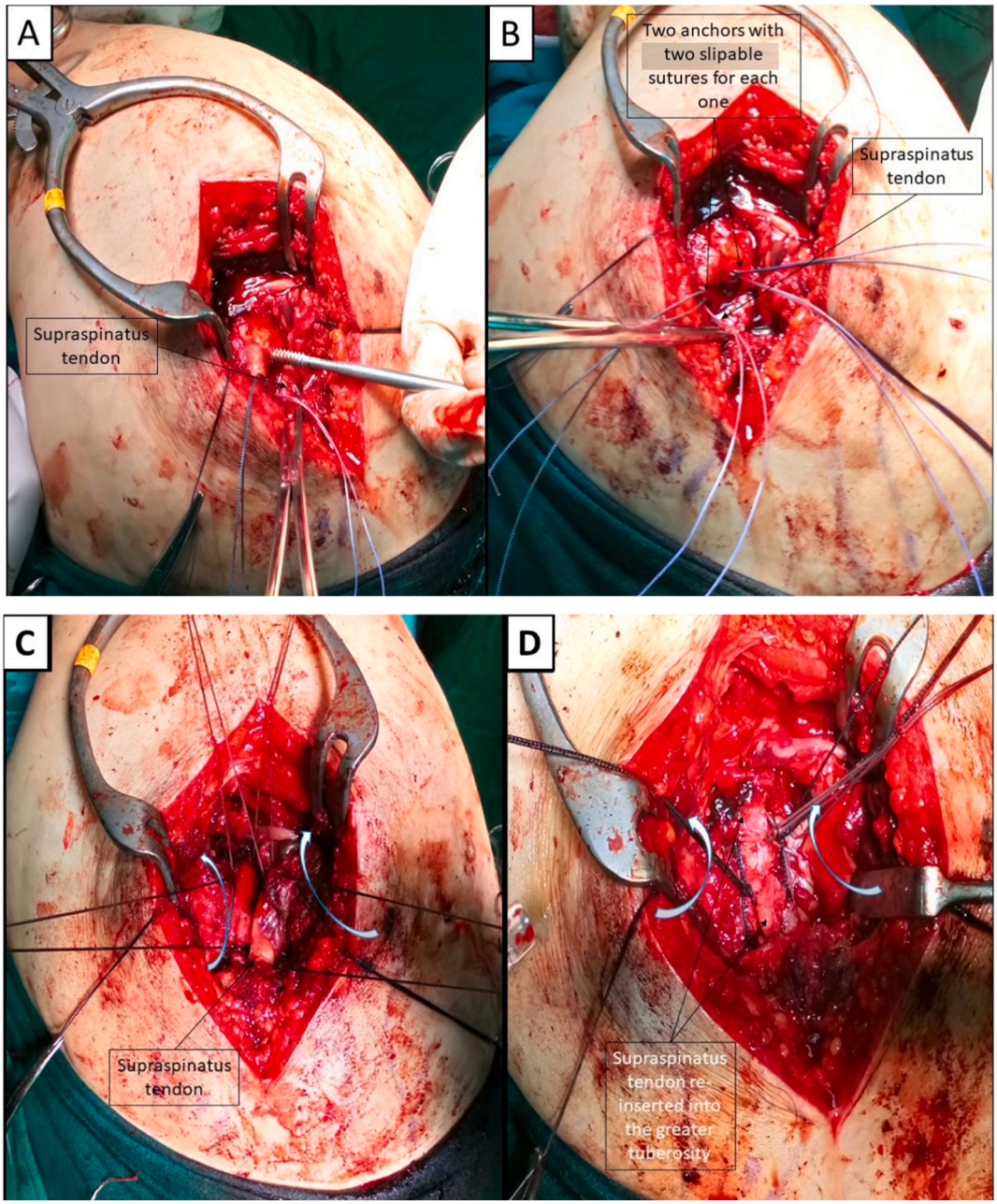


**Fig. 4.** A) The first anchor is inserted, and the second hole is being prepared by taper. B) The two anchors with two slipable sutures for each one C) supra-spinatus tendon was sewn with one arm of each slipable suture, then pulled towards the original insertion onto the greater tuberosity of humerus. B) Four strong knots fix the sutured tendon to the greater tuberosity.

[24]. Schmucker et al. concluded that regarding the endpoints shoulder function and shoulder pain, surgery (performed arthroscopically or by means of a minimally invasive technique, including acromioplasty) was superior to non-surgical treatment (also in the long term) for the management of full thickness rotator cuff tears [25].

So, we can figure out that small tears are subject to discussion about the ideal treatment between conservative treatments and arthroscopic repair. But the big tears (> 4 cm) need to be repaired (including avulsions), and single layer suturing is not preferred in these situations, because of the failure rate.

## 4. Conclusion

Sub-acromial injecting of corticosteroids may be a good solution to reduce that pain caused by RCT, but full-thickness tears usually form structural weak points that can become longer and wider with progressive or repetitive forces over time. The scientific debate continues about the effect of transit changes in the structure of the rotator cuff, especially the supraspinatus tendon, in causing a weakening of this tendon's resistance to bruises, and thus increasing the possibility of developing this rupture when exposed to moderate and severe bruising. The neglect and delay in re-implanting the severed tendon in its place is one of the most important factors leading to the occurrence of fibrosis, adhesions, and the retraction of the tendon away from its anchor, which hinders the possibility of pulling and re-implanting it by arthroscopic surgery, which makes it necessary to move to open surgery to do this. Technically, the doubling of the surgical knots and the transverse entry through the tendon are among the most important factors for success in restoring the function of this tendon, which is offered by open surgery more than arthroscopically.

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## Ethical approval

This study is exempt from ethical approval in our institution.

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Registration of research studies

Not applicable.

## Guarantor

Abdullah Noufal PhD, MD.

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## CRediT authorship contribution statement

Abdullah Noufal PhD, MD: conceptualization, investigation, data curation, writing, editing and reviewing.

## Declaration of competing interest

The author has no conflicts to disclose.

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