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Spoon Lesion; Supraspinatus Tendon Fibrosis and Redundancy with Superior Shoulder Instability

Basim A.N. Fleega[1*], Moataz Eldeeb[1], Ahmed Kandil[2]

Abstract

Purpose: Functional impingement occurs due to muscle imbalance or rotator cuff disease (loss of the force couples around the shoulder) with or without glenohumeral instability that leads to upward migration of the humeral head and narrowing of the subacromial space. In this study, a new supraspinatus dysfunction (Spoon lesion) causing superior instability and secondary impingement as described by the first Author will be presented as well as its arthroscopic diagnostic method (spoon test) and treatment.

Methods: Both clinical, radiological and arthroscopic assessment were done to 55 cases of Spoon lesion, as described above who were treated with arthroscopic resection and tendon reefing in two centers by the same surgeon, between August 2012 and January 2022. 48 cases of primary Spoon lesion and 7 cases of secondary spoon pathology,; 5 of them were cases of Spoon following anterior instability and 2 following Antro-inferior instability, were operated. Arthroscopic resection of the supraspinatus insertion and lateral transosseous suture tension reefing refixation using the Giant needle technique was done to all cases. The seven secondary cases also had an arthroscopic anterior cruciate anterior inferior capsular shift. All patients had a three phases rehabilitation program over a period of 10 weeks to four months.

Results: 48 out of 55 were re-examined with an average follow-up of eight years and 3 months (between 24 months and 12 years). The Neer score was used to evaluate the patients. 43 cases out of the 48 with isolated Spoon lesion achieved an improvement in the score from preoperative unsatisfactory to excellent in 42 (97%) cases and satisfactory in one. The 5 cases of Spoon lesion with instability were all rated excellent.

Conclusions: This study showed the explanation of many cases of impingement like symptoms of the shoulder not responding to treatment although there is no subacromial narrowing nor partial tear. The radiological evaluation, the arthroscopic findings and the histological evaluation are clear signs of a Spoon lesion. Level of evidence IV.

Keywords: Muscle imbalance; Rotator cuff disease; Coracoacromial arch; Tendon; Athletes

Introduction

The incidence of partial tear of the rotator cuff tendons is between 17% and 37% in the population [1,2]. Shear stresses that affect the supraspinatus tendon due to narrowing of the coracoacromial arch (extrinsic impingement) have been identified as a plausible cause of rotator cuff injury as they may

Affiliation:

[1]AlSalaam International Hospital Maadi Cairo, Cairo Egypt

[2]Faculty of Medicine, Alexandria University, Egypt

***Corresponding Author:**

Basim A.N. Fleega, AlSalaam International Hospital Maadi Cairo, Cairo - Al Wosta, Athar an Nabi, Dar El Salam, Cairo Governorate, Egypt.

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generate a laminated disrepair of the surfaces of the cuff [3]. Classification of the partial tear depends on the size and location [1,4]. Repetitive microtrauma may also cause articular surface tears especially when associated with overhead activities [5]. Internal impingement as termed by Walch and colleagues [6] has been demonstrated as another possible reason for the PASTA (Partial Articular Supraspinatus Tendon Avulsion) lesion in overhead athletes.

Apart from contractile muscle imbalance, the imbalance in the capsule is often seen with overstretched ligaments of the glenohumeral joint such as the posterior band of the inferior glenohumeral ligament (IGHL) contributes to altered shoulder kinematic [7]. Functional impingement occurs due to muscle imbalance or rotator cuff disease (loss of the force couples around the shoulder) with or without glenohumeral instability that leads to upward migration of the humeral head and narrowing of the subacromial space. In this study, a new supraspinatus dysfunction (Spoon lesion) causing superior instability and secondary impingement found mainly in young and middle-aged patients with overhead activity and high professional athletes who made 31% of the cases, mainly handball and water polo players as well as swimmers, will be presented as well as its arthroscopic diagnostic method (spoon test) and treatment (Table1).

Table 1: Arthroscopic diagnostic method (spoon test) and treatment.

AGE			GENDER		31% PROFESSIONAL ATHLETES				Prev. Surgery
<40Y	>40y	Av.	MALES	FEMALES	Hand ball	swimmers	Contact sport	others	SAD
29	26	34	20	35	5	5	5	2	21

Etiology

Spoon lesion is described as the elongation and redundancy of the Supraspinatus tendon which looks like a Spoon head when under intraarticular water pressure of 80mmHg during arthroscopy (Figure 1) (Video 1).

Overuse of shoulder elevation over 80 degrees abduction can produce repeated micro-trauma to the critical hypo-vascular area of the supraspinatus tendon leading to increased fibrous tissue in the tendon as the results of the histological findings have shown in this study (Figure 2 a-b), and thus causing its elongation and redundancy that makes the head of the humerus no longer secured in the inferior glenoid fossa with upward migration of the head by the over pulling of the deltoid. Also, hyperlaxity of the glenohumeral ligaments and capsule causing enlargement and redundancy of the anterior capsular ligaments can also be combined with elongation of the capsule-ligament conjoined Supraspinatus tendon causing superior head migration. If the joint is unstable with increased anterior and inferior humeral translation as in case of multidirectional instability, it allows the ball of the shoulder to shift upwards in the socket pinching the tendons and bursa.

The causes can be summarized into primary and secondary; Primary Overuse Microtrauma due to elevation of the arm over 80 degrees abduction as seen with overhead throwing, volleyball players, swimmers, gymnasts can cause repeated micro-trauma to the critical hypo-vascular area of the supraspinatus tendon leading to increased fibrous tissue in the tendon, as the histological findings has shown in this study and thus causing its elongation and redundancy that makes the head of the humerus no longer secured in the inferior glenoid fossa with upward migration of the head by the overpulling of the deltoid. Also, Secondary to anterior or posterior Instability, if the joint is unstable with increased anterior, posterior or inferior humeral translation, it allows the ball of the shoulder to shift upwards in the socket pinching the tendons and bursa causing stretching of the tendon and capsule which leads to superior migration instability and secondary impingement (Figure 3).

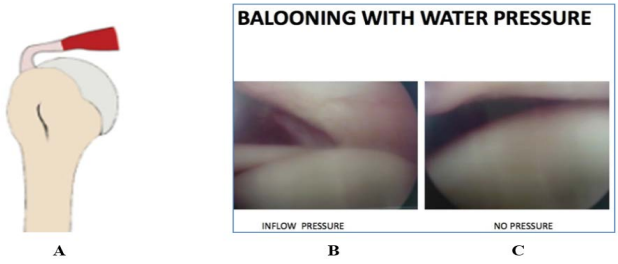

Figure 1: SPOON LESION; A) Redundant ballooning spoon head shape of the Supraspinatus tendon. B) Ballooning of the tendon with increase intraarticular water pressure and C) showing collapse of the tendon without water pressure (Spoon Phenomenon).

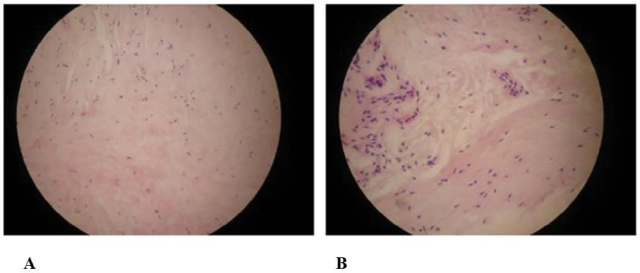

Figure 2: A) Histology of a biopsy of the Supraspinatus tendon of a spoon lesion showing increased fibrous cells, which is maybe a result of tendinosis/Tendenitis due to overhead microtrauma, causing weakness of the tendon and enlargement leading to decrease of the head dynamic compression activity of the tendon during elevation and thus superior instability and secondary impingement during overhead activity. B) Biopsy of a normal Supraspinatus showing much less fibrous cells.

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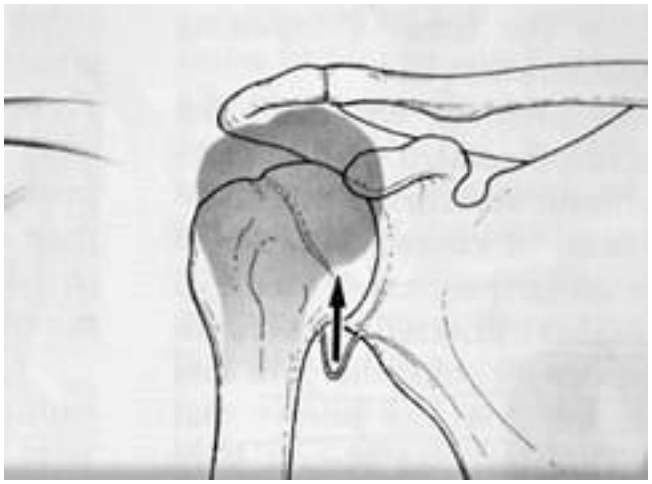

Figure 3: Superior migration of the head of an antroinferior or multidirectional instable shoulder during abduction and elevation causing stretching of the superior stabilizers (Spoon lesion) and superior instability (Neer 1990).

Diagnosis

The symptoms are mainly secondary impingement symptoms and signs not responding to conservative treatment, so we hypothesize it is due to superior dynamic instability causing superior migration of the head during elevation [8].

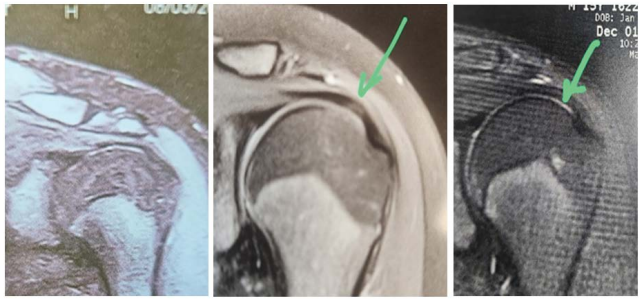

Figure 4: MRI showing Spoon lesion with ballooning of the supraspinatus according to our assessment causing superior instability and therapy resistant secondary impingement needing reefing of the supraspinatus capsule tendon complex to get a dynamic fixation of the head during abduction and thus preventing the superior migration. There is no tear in the tendon, there is only elongation and redundancy causing an increase in the space between the tendon and head. The tendon may be thinned compared to its insertion to the greater tuberosity (B), present in 37 cases (67%) or has the same width to its insertion to the greater tuberosity as present in 18 cases (33%) (C).

In overuse superior unidirectional instability, patients usually complain of pain with overhead activity not related to trauma. Impingement sign and impingement test as proposed by Neer may be positive [3]. In cases of secondary superior instability due to anterior inferior instability microtrauma, both the anterior and sometimes inferior apprehension tests are positive in addition to the positive impingement test. In some cases, with generalized ligament laxity the thumb lower arm instability test is zero centimeter as well as the anterior subluxation test is positive. Ultrasound imaging is an appropriate technique for assessment of rotator cuff tears and has been proved to be valuable for diagnosis of both FTRCTs and PTRCTs [9], but in case of spoon lesion it shows only thinning of tendon which is unreliable for the diagnosis of spoon lesion.

The MRI examination without dye is significant for this lesion as it may show thinning and ballooning of the supraspinatus tendon as shown in (Figure 4). In most cases there is no narrowing of the subacromial space. The rotator cuff is intact with no partial tear or other pathology.

Arthroscopic Signs:

Spoon Phenomena (Test):

The standard position for the arthroscopic examination and treatment is with the patient in a sitting and the arm hanging Figure 5. Increasing the intraarticular water pressure of the glenohumeral joint to 80 mmHg shows ballooning of the supraspinatus tendon giving a spoon-like shape which diminishes with lowering of the pressure as called spoon phenomena as shown in (Figure 1) and Video 1.

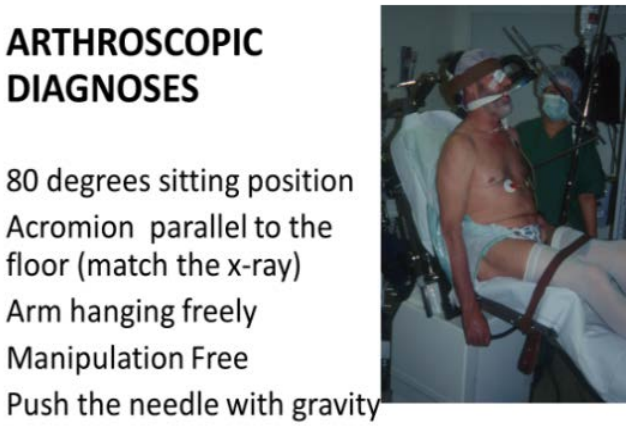

Figure 5: Position of the arthroscopy.

Anterior Subluxation signs:

The head apex reaches the anterior ¼ of the Glenoid and more due to redundant hyperlaxe anterior capsule. This can be positive in cases if antero-inferior instability causing secondary Spoon lesion.

Inferior Subluxation sign:

While pulling the arm down the head apex reaches the lower 1/2 of the Glenoid due to hyper-redundancy and hyperlaxity. Usually is positive in secondary Spoon lesion. In

summary the diagnosis of spoon lesion is based on the MRI finding (Figure 4), the presence of impingement symptoms and signs as well as the positive findings of supraspinatus tendon ballooning and positive spoon test (Figure 1).

Treatment

Treatment should start with rest and oral nonsteroidal anti-inflammatory drugs may be beneficial for reduction of pain and inflammation [10]. Therapeutic ultrasound seems to help reverse tendinosis [11]. Myofascial massage of trigger points located in the shoulder girdle soft tissue seems to be more effective than placebo in terms of pain and shoulder function in patients suffering from shoulder disorders [12,13]. Once pain is manageable, physical therapy should proceed to restore the ROM deficits and strengthening [14,15]. Restoration of neuromuscular coordination and core stability [16,17] (Table 2).

If conservative treatment failed arthroscopy is indicated.

Stages	Rest	Anti-inflammatory	Ultrasound	Myofascial massage	Restore range of motion	Strengthening and Neuromuscular coordination	Core stability	Arthroscopic surgery
Early Pain 2 weeks	x	x						
Pain resistant	x	x	x	X				
Pain manageable					x	x	x	
Persistent pain 6 Months								x
Persistent dysfunction 6 Months								x

Table 2: Treatment plan of the stages of the Spoon lesion to restore the ROM deficits and strengthening, as well as restoration of neuromuscular coordination and core stability

Arthroscopic assessment:

A positive Spoon phenomenon (test) is present in both the primary and secondary Spoon lesion. Anterior, inferior or both subluxation tests are positive in secondary spoon lesion.

Arthroscopic treatment:

The arthroscopic treatment is done by reefing the tendon using the Giant Needle technique (Figure 6). An arthroscopic surgery is done to release the insertion of the supraspinatus tendon, do abrasion of the footprint to get a bleeding surface and pull the tendon laterally and fix it to the footprint area under tension using the Giant Needle transosseous suture refixation technique [18].

In case of a secondary Spoon lesion a reefing is done to the Supraspinatus tendon as well as anterior cruciate inferior capsular shift [19]. The shoulder will be then immobilized for 4-6 weeks to allow anatomization of the capsule ligament apparatus.

Material and Methods

55 cases of Spoon lesion treated with arthroscopic resection and tendon reefing between 2012 and January 2022 were done in two centers by the same surgeon after more than 6 months conservative therapy. The patients presenting with unexplained shoulder pain on throwing and overhead activity underwent arthroscopic examination and treatment. There were20 males and 35 females. 29 patients were below 40 and 26 above 40 years. They were between 16 and 73 years old with an average age of 34 years.

The dominant side was involved in 49 cases. There were 17 high professional athletes (including 4 swimmers, 3 overhead and 3 contact athletes). Ten had primary Spoon lesion and five were cases of Spoon + anterior instability (4 overhead athletes, 1 contact sport) and 2 Spoon with Antro-inferior instability (2 overhead athletes). The MRI All 55 cases showed ballooning of the tendon on MRI and had a positive arthroscopic spoon test [21]. 38% of the cases had a previous failed arthroscopic subacromial decompression. Seven cases, all high professional athletes, had additional instability: five of them anterior instability and 2 Antro-inferior instability. There were 48 cases with primary Spoon lesion. One case had subacromial narrowing type 1 (9mm), all others were type zero which is a subacromial space of more than 12mm space as measured between the anterior acromion and the supraspinatus using a special measuring needle intra-arthroscopically in a sitting position [18]. There were five cases of anterior instability and two with multidirectional instability and all were athletes.

A small about 4 mm biopsy was taken during the arthroscopy of the tendon where the redundancy was seen about, 5mm from medial to the tendon insertion, and a histological study was done to the material taken. Resection of the Supraspinatus tendon at its insertion and transosseous

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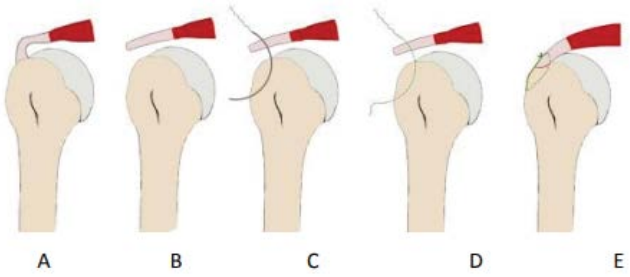

Figure 6: Arthroscopic treatment A; Spoon lesion; B: after resection of the tendon from its insertion; C: passing the Giant Needle medially through the tendon and bone; D: suture through. E; transosseous refixation and reefing.

refixation under tension reefing using the Giant needle technique was done to all cases, while tendon reefing with cruciate anterior capsular shift in cases was done in cases with anterior instability and tendon reefing with cruciate anterior inferior capsular shift in cases with Spoon lesion with antro-inferior instability. One case had a subacromial decompression (Acromioplasty) for a subacromial space of 9mm. All patients underwent a three phases postoperative rehabilitation program of passive assisted exercises, followed by isometric and active assisted stretching and finally strengthening and advanced stretching exercises. The rehabilitation program [20] started the second day after surgery in Spoon lesion with only reefing and after 6 weeks in cases of spoon reefing with inferior capsular shift. The rehabilitation till complete recovery took 3 to 4 months in all cases except in 8 patients were 5 to 8 months were needed. A reevaluation with an average follow up of 8 years and 3 months (between 2 and 12 years) was made.

Results

The biopsy taken was examined histologically and showed an increase in fibrin cells compared to the normal tendon histology (Figure 2). A reevaluation with an average follow-up of 8 years and 3 months (between 2 and 12 years) was done. 38 cases were physically re-examined and 10 had a telephone video assessment. Seven cases (6 only spoon and 1 spoon with instability) were lost. The methodology we used was the Neer scoring system based on evaluation of pain, strength, function, range of motion) to evaluate the preoperative and postoperative results of the 43 cases with primary Spoon lesion and 5 cases with secondary spoon lesion.

The improvement in the score of pain and function were dramatically obvious progressing with time at 6w, 3m, 6m and one year. The preoperative superior instability impingement pain was diminished in all the 48 reexamined Patients. The positive preoperative sign which was positive in all cases before surgery became negative after surgery. The range of motion was equal to the normal opposite side in the preoperative as well as the postoperative evaluation of an average 180 degrees elevation, 60 external rotation and T4 internal rotation. The strength of elevation in 90 degrees abduction compared to the opposite normal side improved from average 87% to 98% with consideration to the dominant side. Also, the external rotation strength in adduction was equal to the opposite side, both preoperative and postoperative in the study. All patients returned to preinjury level of sport performance. The 43 cases with isolated Spoon lesion achieved an improvement in the score from preoperative unsatisfactory to excellent in 42 cases and satisfactory in one. The 5 cases of Spoon lesion with instability were all rated excellent. No complications were found.

Discussion

In this study, a new supraspinatus dysfunction (Spoon lesion) and its arthroscopic diagnostic method (spoon test) is presented. Spoon lesion, a new finding described by the first Author as the elongation and redundancy of the supraspinatus tendon causing its dysfunction that can lead to functional impingement. The supraspinatus tendon will extend superiorly and look like a spoon under intraarticular water pressure during arthroscopy and will fall back to the head after removal of the water pressure to be described as a positive spoon test. The spoon lesion can be isolated, affecting the supraspinatus causing only a secondary impingement or in combination with instability.

Subacromial impingement syndrome accounts for 44-65% of all shoulder complaints in the normal population and it is also commonly seen in athletes [21]. It is basically due to narrowing the subacromial space by any etiology [22]. According to the underlying shoulder abnormalities, subacromial impingement syndrome can be classified into primary (structural) or secondary (functional) impingement [3,4]. Structural impingement occurs due to bony or soft tissue abnormalities that lead to the compression of the subacromial space structures (the rotator cuff tendon, long head of biceps, and the subacromial bursa) between the acromion, acromioclavicular joint, coracoacromial ligament, and the humeral head during the forward elevation or abduction of the humerus [3, 23].

On the other hand, the functional or secondary impingement occurs due to muscle imbalance or rotator cuff disease (loss of the force couples around the shoulder) with or without glenohumeral instability that leads to upward migration of the humeral head and narrowing of the subacromial space [24]. It was found that functional impingement is more common in younger age and overhead athletes, while structural impingement occurs more in older patients [4].

Many studies have declared that rotator cuff pathology, glenohumeral instability, and multidirectional instability as causes of functional impingement. However, and in the

meanwhile, no known studies have shown us a reproducible method to diagnose the supraspinatus dysfunction that leads to functional impingement. An analysis was done to the cases of impingement like symptoms not responding to treatment either conservative or surgical in the form of subacromial decompression nor having subacromial narrowing, supraspinatus tear or instability that could justify their complaint. Spoon lesion as described above has not been mentioned in the literature before. It is a cause of many unexplained shoulder pain especially in overhead athletes and cases with failed subacromial decompression surgery. We believe that supraspinatus elongation and redundancy may be congenital or due to repeated overhead activities that led to microtrauma, fibrous tissue formation and tendon elongation. This may be the reason that it is mainly seen in overhead athletes.

In our study, we confirmed the findings of arthroscopic supraspinatus redundancy (spoon lesion) by taking a biopsy from the supraspinatus tendon. It has shown increased fibrous tissue cells in the tendon denoting its pathology. There are several limitations in our study. As this is a new description of the Supraspinatus pathology causing superior glenohumeral instability and secondary Impingement with a special treatment method, there is no control group to compare different methods of treatment. Second, no postoperative MRI was done to assess the structural integrity of the tendon after our repair.

Conclusion

This study showed the explanation of many cases of impingement like symptoms of the shoulder not responding to treatment although there is no subacromial narrowing nor partial tear. The radiological evaluation, spoon test and histological findings are clear signs of the lesion. The long-term results of an average of more than 6 years of the transosseous arthroscopic reefing resolved this problem completely.

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