

Outcome of arthroscopic subscapularis tendon repair: Are the results improving with improved techniques and equipment?

A retrospective case series

G R Arun¹, Pradeep Kumar, Sarthak Patnaik, Karthik Selvaraj, David Rajan, Anant Singh², Vinay Kumaraswamy

ABSTRACT

Background: Rotator cuff tears are a common cause of shoulder pain and dysfunction. More recently, there has been a renewed interest in understanding the subscapularis tears. There are multiple articles in the literature showing the short term results of isolated subscapularis tendon repair. However, the midterm and long term outcome studies for arthroscopic subscapularis repair are few. This study evaluates the functional outcome after arthroscopic subscapularis repair.

Materials and Methods: The records of 35 patients who underwent an arthroscopic subscapularis repair between May 2008 and June 2012 were included in this retrospective study. The records of all patients were reviewed. There were 22 males and 13 female patients with mean age of 58.2 years (range 41-72 years). All patients had a complete history, physical examination, and radiographs of their shoulders. Visual analogue scale (VAS), range of movements, power of cuff muscles, and modified University of California at Los Angeles (UCLA) score were assessed.

Results: The mean followup was 2.8 years (range 2-4 year). Functional outcome after arthroscopic subscapularis repair has an excellent outcome as analysed by clinical outcome, VAS score and UCLA score. Results were analyzed and had statistically significant values. The VAS for pain improved significantly ($P < 0.001$), and the mean modified UCLA score improved significantly ($P < 0.001$) from 14.24 ± 4.72 preoperatively to 33.15 ± 2.29 at 2 years postoperative. According to the UCLA system, there were 22 excellent, 11 good, and 2 fair results. Around 95% of patients returned to their usual work after surgery.

Conclusion: At a median followup of 2 years, 95% of patients had a good to excellent result after an arthroscopic subscapularis tendon repair. We conclude that the midterm results show that arthroscopic subscapularis repair remains a good option for the treatment of patients with subscapularis tendon repair.

Key words: Arthroscopy, rotator cuff, subscapularis repair, University of California at Los Angeles classification

INTRODUCTION

Rotator cuff tears are a common cause of shoulder pain and dysfunction. Subscapularis tendon is one of the four rotator cuff tendons which in addition include

supraspinatus, infraspinatus, and teres minor. Subscapularis inserts onto the lesser tuberosity of the humerus, whereas the other rotator cuff tendons insert into the greater tuberosity.¹ In 1834, Smith was credited as describing the first case series of subscapularis repair.¹ Tears, involving the subscapularis tendon, have not been considered as common. Autopsy and cadaveric studies have shown the incidence of subscapularis tears to be between 3% and

Ortho One Orthopaedic Speciality Centre, Coimbatore, Tamil Nadu, ¹Department of Orthopaedics, Mysore Medical College, Mysore, Karnataka, ²Department of Orthopaedics, AIIMS, Raipur, Chhattisgarh, India

Address for correspondence: Dr. G R Arun, No-448, 17th Cross, Vishweshwaranagar, Mysore - 570 008, Bangalore, Karnataka, India. E-mail: drgrarun@gmail.com

Video Available on: www.ijoonline.com

Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: ***

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: ???

13%.⁸ More recently, there has been a renewed interest in understanding the subscapularis muscle tears. In just the past decade, there have been several articles dedicated to diagnosing and treating subscapularis tendon tears.^{10,11} As our understanding of the shoulder has increased, so as the rate at which subscapularis tendon tears have been identified. Clinical examination supported by radiological investigations has helped in identifying subscapularis tendon tears.² Subscapularis tears can be isolated,²⁻⁵ part of the anterosuperior rotator cuff tear,⁶⁻¹¹ or a continuum of large and massive rotator cuff involvement.¹² However, the authors could not find from literature the incidence of isolated subscapularis or combined subscapularis and other rotator cuff tendon tears.

Subscapularis tendon tears have been most frequently classified according to Lafosse *et al.* (2007) grading system from grade 1 to 5.¹³ There are several articles published showing the short term results measuring the outcome of open repair and arthroscopic subscapularis repair.^{12,14,15} However, the midterm and long term outcome studies for arthroscopic subscapularis repair are few. We studied the midterm functional results of subscapularis tendon repair in association with repair of other cuff muscles.

MATERIALS AND METHODS

35 patients who underwent arthroscopic rotator cuff repair between May 2008 and June 2012 were included in this retrospective study. The records of all patients were reviewed. There were 22 males and 13 female patients with mean age of 58.2 years (range 41-72 years). The minimum clinical followup for this study was 2 years. Rotator cuff tears were diagnosed on clinical examination and magnetic resonance imaging (MRI) findings [Figures 1 and 2]. Clinical tests included the Gerber's lift-off test, Bear-hug test, and

Belly-press test along with an assessment of other rotator cuff tendons. Radiological evaluation was done with 1.5T MRI by an experienced musculoskeletal radiologist reporting on the scans. Inclusion criteria were (1) All patients who underwent arthroscopic isolated subscapularis or combined subscapularis and other rotator cuff tear repairs (2) Minimum 2 years followup postoperatively. The exclusion criteria were (1) Rotator cuff tears treated by open methods (2) Massive irreparable rotator cuff tears (3) Cases of glenohumeral arthritis (4) Cases with severe cuff tear arthropathy (Hamada *et al.* classification grade 3 or more and above).¹⁶

All operations were performed by the senior authors together (DR and KS). Only patients with confirmed partial to full thickness subscapularis tears were included in this study. All patients gave informed consent to participate in this study.

In the followup, all patients were subjected to thorough physical examination, including lift-off test, belly-press test, and bear-hug sign. Visual analogue scale (VAS) and modified University of California at Los Angeles (UCLA) score were calculated. All patients were asked to list all of their current activities and state of their satisfaction with their shoulders. The physical examination also evaluated their active range of motion and graded their strength throughout their range of motion on a scale from 0 to 5 according to MRC. All the data were analyzed statistically using paired *t*-test and "P" value was calculated using SPSS 18 software [IBM, Chicago, USA].

We repair all subscapularis tendon tears arthroscopically using metal suture anchors. We start with repair of the subscapularis tendon before addressing any other pathology in shoulder as recommended in literature.^{2-4,12}

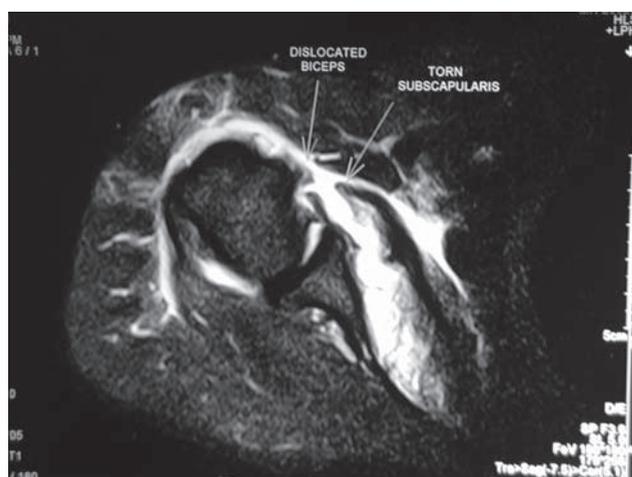


Figure 1: Magnetic resonance imaging axial cut showing the subscapularis tear



Figure 2: Magnetic resonance imaging sagittal view showing subscapularis tear

Operative procedure

All surgeries were performed with the patients in beach chair position. A standard posterior portal was used to perform a routine glenohumeral diagnostic arthroscopy. A 70° arthroscope was also used while performing subscapularis repair for better visualization. Subscapularis tendon edges were freshened using shaver, and the lesser tuberosity surface was made raw using a rasp. A good debridement of tendon edges and medial and inferior release is necessary for completely retracted subscapularis tendon tears for optimum repair. All subscapularis repairs were performed using 5 mm metal suture anchors (double loaded, Arthrex) [Figure 3]. Subscapularis tendon insertion is 2.5 cm in width and generally one double loaded suture anchor suffices if <50% of the tendon is torn. If > 50% of tendon insertion is torn two suture anchors are used. Upon completion of the repair, the arm is internally and externally rotated to confirm the completeness of the repair [Figure 4].

Subscapularis tendon tears were classified according to Lafosse's *et al.* classification.¹³ Associated supraspinatus and infraspinatus tendon tears were also documented and classified according to the thickness of the involved tendons and were repaired.

All patients were given a sling with a wedge, applied in the operating room. The sling is worn full time for 6 weeks; however, the wedge was removed after 4 weeks. During the first 6 weeks, patients are instructed to perform active elbow flexion and extension with arm at the side. After 6 weeks, patients begin a passive stretching program that includes overhead stretches with a rope and pulley. After 12 weeks, we start strengthening program with elastic bands.

RESULTS

25 (71.4%) patients presented with Lafosse grade 2 tears

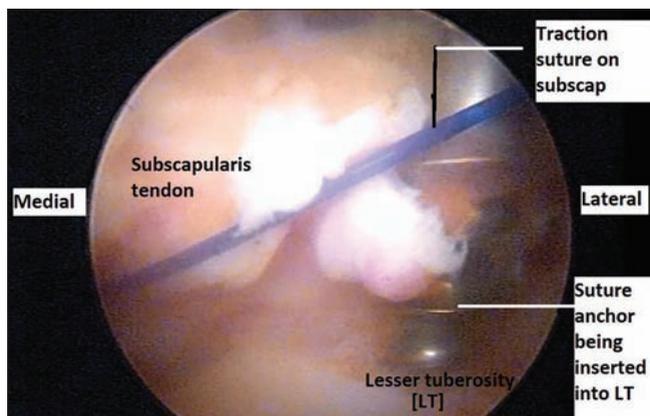


Figure 3: Arthroscopic view showing the insertion of the suture anchor into the lesser tuberosity during subscapularis repair. The viewing is through a 70° arthroscope

and 7 (20%) patients with grade 1 tear [Table 1]. Combined rotator cuff tears were more common (71.4%) than isolated subscapularis tear (28.6%) [Table 2].

Mechanism of injury was most commonly traumatic fall (70%) in the cases of isolated subscapularis tears (7 out of 10). However, combined rotator cuff cases did not give a history of significant trauma in most cases and were degenerative in origin (76% cases, 19 out of 25 cases). Isolated subscapularis tear also tends to happen at a younger age (mean 52.3 years) as compared to the occurrence of subscapularis tears along with other rotator cuff tendon tears (mean age 63.4 years).

The mean VAS score decreased significantly from 8.03 in preoperative period to 1.44 in the postoperative period. This was statistically significant. The UCLA score increased significantly from 14.24 preoperatively to 33.15 in the postoperative followup. Elevation and external rotation also improved significantly after surgery. According to the UCLA system, there were 22 excellent, 11 good, and 2 fair

Table 1: The grading of subscapularis tears found in this study

Subscapularis tear grading (Lafosse)	Number of patients	Percentage prevalence
Grade 1	7	20
Grade 2	25	71.4
Grade 3	2	5.7
Grade 4	1	2.85
Grade 5	0	-

Table 2: The pattern of rotator cuff tears

Rotator cuff tears pattern	Number of patients	Percentage prevalence	Mean age (in years)
Isolated subscapularis tear	10	28.5%	52.3
Combined subscapularis and other rotator cuff tendon tears	25	71.4%	63.4

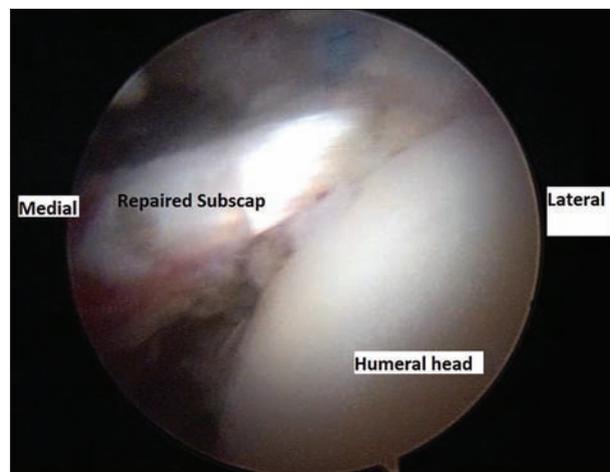


Figure 4: Arthroscopic view showing complete subscapularis repair and the complete coverage of the lesser tuberosity by the subscapularis tendon. The area is being viewed through a 70° arthroscope

results among 35 patients. Around 95% of patients returned to their usual work after surgery. Elevation increased from 73.68° to 170.88°. External rotation increased from 23.09° to 71.18°, and internal rotation increased from L5, S1 to T7 in the followup [Figures 5 and 6].

Power of cuff muscles increased from a mean of 2.5 to 4.74 in elevation, 2.24 to 4.79 in external rotation, and 2.29 to 4.82 in internal rotation. Power of the muscles was tested according to MRCS classification (grading). Persistent Belly-press and lift-off positive postsurgery were found in 14.28% cases (5 out of 35).

Thus, the postoperative results of both isolated and combined rotator cuff tears were comparable after arthroscopic repair as 2 years postoperative VAS and UCLA scores were not significantly different in both groups $P = 0.23$ and 0.12 , respectively.

DISCUSSION

The present study represents the largest series to date in patients with rotator cuff injury that have been treated with an all arthroscopic subscapularis tendon repair. Several authors have reported on clinical outcomes after open repair of isolated subscapularis tendon tears.^{2,14} We identified only a few studies reporting the results of arthroscopic repair of subscapularis tendon tears.^{12,15,20} The present study shows the good results after arthroscopic repair of subscapularis tears (mean post of UCLA 33.15 and mean VAS 1.44). The results of both isolated subscapularis and combined subscapularis and other tendon tears were comparable [Table 3].

Mechanism of injury was most commonly traumatic fall (70%) in the cases of isolated subscapularis tears,

whereas combined rotator cuff cases were degenerative in origin (76% cases). Isolated subscapularis tear also tends to happen at a younger age (mean 52.3 years). All these data indicate that the etiopathogenesis of isolated subscapularis tear may be different to that of the occurrence of subscapularis tear along with other rotator cuff tendon tears.

Bennett¹² (2003) published a series of 8 patients with 2 years followup after arthroscopic repair of isolated subscapularis tendon tears. The postoperative constant score was 74 points, but no information was given about postoperative clinical subscapularis tests or structural integrity of the repair. Adam *et al.* (2000)¹⁷ reported excellent results after arthroscopic repair of isolated subscapularis tears in 7 patients after a minimum followup of 3 years. Lafosse *et al.*¹⁸ (2007) studied 17 patients, the first series with detailed information on postoperative results of arthroscopic subscapularis repair for isolated tears. They found good clinical results with a postoperative constant score of 84 points in 17 patients after a followup of 29 months, a rerupture rate of 12% evaluated by computed tomography arthrograms, and a rate of persistent positive or weakened belly-press tests in 24% of patients.

In a multicenter study, Edwards *et al.*¹⁹ reported the results of open repair in 84 isolated subscapularis tendon tears. The constant score averaged 79.5 points after 45 months. Marked fatty infiltration of subscapularis muscle negatively influenced the postoperative belly-test, but postoperative constant score was not influenced by fatty degeneration. Additional tenodesis or tenotomy of long head of the biceps had a significant positive influence on the outcome. The rerupture rate was assumed to be 13% based on clinical and radiological findings.



Figure 5: Clinical photograph full elevation on right side after two years followup



Figure 6: Clinical photograph showing internal rotation after two years followup

Table 3: The preoperative and 2 years postoperative VAS and UCLA scores and range of movements

Comparison criteria for evaluation of subscapularis repair	Mean	SD	t	P
UCLA score pre	14.24	4.729	-25.344	0.0001
UCLA score postsurgery	33.15	2.298		
VAS pre	8.03	1.193	31.136	0.0001
VAS post	1.44	0.561		
Elevation pre	73.68	25.975	-20.446	0.0001
Elevation post	170.88	8.300		
External rotation pre	23.09	10.300	-18.852	0.0001
External rotation post	71.18	8.444		

VAS=Visual analogue scale, UCLA=University of California at Los Angeles, SD=Standard deviation

Gerber and Krushell³ (1991) reported on 16 patients with an average followup of 43 months and a score of 82% in the age and gender matched constant score after open repair of an isolated subscapularis tear. Gerber *et al.*⁴ and Edwards *et al.*¹⁹ each reported persistent positive lift-off and belly-press tests in the postoperative course representing a partial subscapularis muscle insufficiency at a rate of 31% and 20%, respectively. It was shown that positive postoperative subscapularis tests were not indicative of a poor clinical outcome, as their patients did not achieve lower constant scores, but Edwards *et al.*¹⁹ stated that the community used shoulder scores do not adequately reflect subscapularis muscle strength. Persistent belly-press and lift-off positive postsurgery were found in 14.28% cases (5 out of 35) in this series. We agree with Gerber *et al.*⁴ and Edwards *et al.*¹⁹ that positive postoperative subscapularis tests were not indicative of a poor clinical outcome, as their patients did not achieve lower shoulder scores.

In a study by Burkhart and Tehrany,²⁰ (2002) the authors were first to describe the technique and preliminary results of arthroscopic repair of the subscapularis tendon. This study evaluated 25 patients with a mean age of 61 years who had either anterosuperior or isolated subscapularis tendon tears repaired with an arthroscopic surgical technique. The mean followup in this study was 10.7 months with 23 good to excellent results, 1 fair result, and 1 poor result. Warner *et al.*¹⁰ (2001) evaluated 19 patients with a mean age of 58 years in whom they did anterosuperior and subscapularis tendon repairs. The mean followup in their study was approximately 3.3 years with 5 had an excellent result, and 3 had good results. Flury *et al.*²¹ (2006) evaluated 63 patients with a mean age of 56 years who had either anterosuperior or isolated subscapularis tendon tears repaired with an open surgical technique. The mean followup in their study was 2.9 years with 98% patient being satisfied with the operation.

This series is one of the largest series of arthroscopic subscapularis repair and goes on to show the good results

of undertaking such a repair. The surgeon attempting to repair subscapularis would greatly benefit if he also has a 70° arthroscope in his setup. Attempting arthroscopic repair using the routine 30° arthroscope can be quite challenging. The limitations of study are that this study is a case series (level 4 evidence). The ideal study design to see the results of subscapularis repair would be to compare operative and nonoperative groups. However, we cannot undertake such a study because we tend to repair all our diagnosed subscapularis tears.

We conclude that the midterm results of arthroscopic subscapularis tendon repair are good, and it remains a good option for the management of subscapularis tendon tear along with other rotator cuff muscle repair.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Smith JG. Pathological appearances of seven cases of injury of the shoulder joint, with remarks. *Lond Med Gaz* 1834;14:280.
- Deutsch A, Altchek DW, Veltri DM, Potter HG, Warren RF. Traumatic tears of the subscapularis tendon. Clinical diagnosis, magnetic resonance imaging findings, and operative treatment. *Am J Sports Med* 1997;25:13-22.
- Gerber C, Krushell RJ. Isolated rupture of the tendon of the subscapularis muscle. Clinical features in 16 cases. *J Bone Joint Surg Br* 1991;73:389-94.
- Gerber C, Hersche O, Farron A. Isolated rupture of the subscapularis tendon. *J Bone Joint Surg Am* 1996;78:1015-23.
- Bernageau J, Goutallier D. Isolated lesions of the subscapularis tendon and internal malpositions of the biceps tendon. Apropos of 45 cases. *J Radiol* 1997;78:1255-63.
- Sakurai G, Ozaki J, Tomita Y, Kondo T, Tamai S. Incomplete tears of the subscapularis tendon associated with tears of the supraspinatus tendon: Cadaveric and clinical studies. *J Shoulder Elbow Surg* 1998;7:510-5.
- Walch G, Nove-Josserand L, Levigne C, Renaud E. Tears of the supraspinatus tendon associated with "hidden" lesions of the rotator interval. *J Shoulder Elbow Surg* 1994;3:353-60.
- Nove-Josserand L, Gerber C, Walch G. Lesions of the

AQ3

- anterosuperior rotator cuff. In: Warner JJ, Iannotti JP, Gerber C, editors. *Complex and Revision Problems in Shoulder Surgery*. Philadelphia: Lippincott-Raven; 1997. p. 165-76.
9. Walch G, Nové-Josserand L, Boileau P, Levigne C. Subluxations and dislocations of the tendon of the long head of the biceps. *J Shoulder Elbow Surg* 1998;7:100-8.
 10. Warner JJ, Higgins L, Parsons IM 4th, Dowdy P. Diagnosis and treatment of anterosuperior rotator cuff tears. *J Shoulder Elbow Surg* 2001;10:37-46.
 11. Ticker JB, Warner JJ. Single-tendon tears of the rotator cuff. Evaluation and treatment of subscapularis tears and principles of treatment for supraspinatus tears. *Orthop Clin North Am* 1997;28:99-116.
 12. Bennett WF. Arthroscopic repair of isolated subscapularis tears: A prospective cohort with 2- to 4-year followup. *Arthroscopy* 2003;19:131-43.
 13. Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Subscapularis tear classification. *J Bone Joint Surg Am* 2007;89:1184-93.
 14. Nathan A. outcomes of arthroscopic and open surgical repair of isolated subscapularis tendon tears. *Arthroscopy* 2012;28:1306-14.
 15. Toussaint B, Audebert S, Barth J, Charousset C, Godeneche A, Joudet T, *et al.* Arthroscopic repair of subscapularis tears: Preliminary data from a prospective multicentre study. *Orthop Traumatol Surg Res* 2012;98 8 Suppl:S193-200.
 16. Hamada K, Fukuda H, Mikasa M, Kobayashi Y. Roentgenographic findings in massive rotator cuff tears. A long term observation. *Clin Orthop Relat Res* 1990;254:92-6.
 17. Adams CR, Schoolfield JD, Burkhart SS. The results of arthroscopic subscapularis tendon repairs. *Arthroscopy* 2008;24:1381-9.
 18. Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Structural integrity and clinical outcomes after arthroscopic repair of isolated subscapularis tears. *J Bone Joint Surg Am* 2007;89:1184-93.
 19. Edwards TB, Walch G, Sirveaux F, Molé D, Nové-Josserand L, Boulahia A, *et al.* Repair of tears of the subscapularis. *J Bone Joint Surg Am* 2005;87:725-30.
 20. Burkhart SS, Tehrany AM. Arthroscopic subscapularis tendon repair: Technique and preliminary results. *Arthroscopy* 2002;18:454-63.
 21. Flury MP, John M, Goldhahn J, Schwyzer HK, Simmen BR. Rupture of the subscapularis tendon (isolated or in combination with supraspinatus tear): When is a repair indicated? *J Shoulder Elbow Surg* 2006;15:659-64.

Author Query???

AQ3: Kindly provide reference citations in chronological order