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Functional Assessment of Hybrid Superior Capsular Reconstruction Technique by Combination of Autologous Fascia Lata and Long Head of Biceps Tendon in Cases with Irreparable Rotator Cuff Tears - Case Series

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Learning Point of the Article:

The combined construct restores superior shoulder stability and contributes to improved functional outcomes and pain relief.

Abstract

Introduction: Rotator cuff tears (RCT) represent one of the most common causes of shoulder pain requiring a visit to orthopedic surgeon, the proper management of these tears depends on several factors, including patient age, symptoms, tear size, tendon retraction, fatty degeneration of cuff muscles and arthritic changes. In this study we emphasize that a combination of fascia lata and biceps tendon used for superior capsular reconstruction (SCR) gives a better outcome.

Materials and Methods: A case series of 11 cases of irreparable RCT (IRCT) regardless the degree of fatty degeneration or atrophy, long head of biceps tendon (LHBT) is intact or has partial tear <20% of diameter with intact attachment to superior labrum, normal tone and power of deltoid muscle and normal pre-operative passive range of motion (ROM) underwent hybrid SCR using combined LHBT and fascia lata and evaluated pre- and post-operative active and passive ROM (forward flexion, abduction, internal and external rotation), Visual Analog Scale pain scores and American Shoulder and Elbow Surgeons scores.

Results: Eleven cases met the inclusion criteria and underwent hybrid SCR, the mean follow-up was 24 months ± 2 months. The mean active forward flexion was improved by 83° increased from 29.09° pre-operatively to 111.82° post-operatively, mean active abduction was improved by 95° increased from 28.18° pre-operatively to 123.64° post-operatively, mean active external rotation was improved by 15° increased from 16.36° pre-operatively to 31.36° post-operatively while mean active internal rotation was improved by 3 levels increased from S1 pre-operatively to D12 post-operatively

Conclusion: Hybrid SCR with a combination of fascia lata and LHBT is a valid choice for IRCT with improved radiological and functional outcomes, active ROM and reversal of pseudoparalysis for more than 2-year follow-up.

Keywords: Fascia lata, biceps, superior capsular reconstruction.

Introduction

Rotator cuff tears (RCT) represent one of the most common causes of shoulder pain requiring a visit to an orthopedic surgeon [1]; the proper management of these tears depends on several factors, including patient age, symptoms, tear size, tendon retraction, fatty degeneration of cuff muscles, and

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arthritic changes [2].

Non-surgical management has shown to be effective even in full-thickness RCT [3], unfortunately not all patients respond to conservative management and those cases require surgical intervention to improve their symptoms and function.

Surgical management includes rotator cuff repair showed good results in both open and arthroscopic repair [4], historically massive RCT was defined as >5 cm [5] or involvement of more than 2 tendons [6] but with advanced arthroscopic techniques and implants these tears may be reparable nowadays, other factors may affect the success rate of repair may include immobile severely retracted tendon which makes tensionless repair impossible and re-tear rates are as high as 94% [7], fatty degeneration of cuff muscles with Goutalleir grade 2 and more revealed tear recurrence in 100% [8], identification of truly irreparable RCT (IRCT) is challenging to orthopedic surgeons currently as it affects long-term outcome [9], elderly low-demand patients with arthritis (Hamada grade 4 and 5) [10] have good results with reverse shoulder arthroplasty [11], but young patients without arthritic changes are challenging.

Management of IRCT without arthritis may include partial repair [12], tendon transfer with latissimus dorsi [13] or lower trapezius [14], bridging interposition graft [15], subacromial spacers [16] and superior capsular reconstruction (SCR) [17] with variable results and outcomes.

SCR was first described by Mihata et al. [18] on cadaveric study showing that fascia lata with 6–8 mm thickness fixed on glenoid medially and greater tuberosity laterally in 15–45° shoulder abduction can decrease superior translation and subacromial peak contact pressure significantly in comparison to 4mm thick fascia lata, which have been confirmed by clinical trials to improve shoulder function and even reverse pseudoparalysis [19].

Despite of SCR with autologous fascia lata had good clinical results [17] but donor site morbidity was its main drawback, alternative technique using semitendinosus autologous graft [20] was described but no clinical trials have been found to assess the outcome, on the other hand acellular dermal allograft with 6 mm instead of 3 mm thickness has shown comparable results to fascia lata on cadaveric study [21], but allograft had shown 15% elongation under physiologic forces on cadaveric study [22], Croom et al. [23] studied patellar tendon allograft on 8 cadaveric models and demonstrated good superior stability and peak acromial pressure without restricting range of motion (ROM), Kim and Nam [24] described a mini-open technique of SCR by using Achilles tendon allograft with key-hole shaped tunnel in humeral head, all these techniques were trying to avoid donor site morbidities of fascia lata harvest but cost and tissue reaction were the main pitfall while using allograft.

Long head of biceps tendon (LHBT) provides a good alternative graft [25,26,27] with numerous benefits; anatomical natural attachment to glenoid acting as a good vascular pedicle with no additional need for anchors which increases time and cost of operation, another advantage of using LHBT that distal tenotomy may relief the pain from co-existing tenosynovitis as a pain generator before surgery, it also acts as static depressor of humeral head when used as graft of SCR, biomechanical studies showed that ultimate tensile strength of LHBT is almost double the strength of supraspinatus tendon (32.5 vs. 16.5 MPa) [28], good diameter at articular margin 6.6 mm [29] makes LHBT a good natural graft for SCR with lower cost and donor site morbidity, the limitations of using LHBT in SCR are inability to use LHBT when it is ruptured or damaged due to chronic overload during rotator cuff disease progression and consequences of distal tenotomy as muscle cramp and Popeye deformity [30], Adrian and Field [31] described a

Table 1: Active range of motion

Case	Forward flexion		Abduction		External rotation		Internal rotation	
	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
1	40	120	20	130	10	45	NP	D12
2	30	140	20	140	10	50	NP	D12
3	30	130	30	170	20	50	S1	D1O
4	10	110	30	160	10	50	L1	D12
5	40	140	40	170	20	50	S1	D12
6	30	130	30	120	20	40	NP	D10
7	30	110	30	140	10	NP	L1	D12
8	20	140	20	150	20	30	S1	D12
9	30	120	30	150	30	30	S1	D12
10	30	60	30	10	10	NP	S1	S1
11	30	30	30	20	20	NP	S1	NP
Mean	29.09	111.82	28.18	123.64	16.36	31.36		
Standard deviation	8.32	34	5.99	55.81	6.74	20.45		

Foootnote: Np- not possible, S1- sacral vertebrae 1, L1- lumbar vertebrae 1

Table 2: Passive range of motion

Case	Forward flexion	Abduction	External rotation
	Post-operative	Post-operative	Post-operative
1	120	130	45
2	140	140	50
3	130	170	50
4	110	160	50
5	140	170	50
6	130	120	40
7	110	140	-
8	140	150	30
9	120	150	30
10	120	150	NP
11	30	20	NP
Mean	117.27	136.36	31.36
Standard deviation	29.54	39.58	20.45

NP- not possible

technique of using LHBT in SCR by rerouting the tendon without distal tenotomy to avoid complications of distal tenotomy but no clinical trials on this technique were found in literature.

SCR with LHBT was compared to SCR with fascia lata on cadaveric study [32] and results showed that force needed for superior migration in LHBT SCR was 393.2% while in fascia lata group was 194.0%, cohort study demonstrated better overall outcome in using LHBT versus fascia lata as SCR grafts [33], on the other hand; retrospective analysis comparing LHBT SCR versus allograft SCR showed lower complication rates in LHBT group [34] while other studies showed no significant differences between them [35].

Fucai han et al. concluded that LHB with appropriate distal insertion on the greater tuberosity restores shoulder stability in IRCT by re-centering the humeral head on the glenoid [36].

Regardless the graft type; SCR success rate depends on other factors as graft thickness, graft tension, side-to-side repair of remnant cuff tendons and acromioplasty [37], native shoulder capsule thickness is 4.4–9.1 mm [38], Denard et al. [39] showed that 1mm thickness allograft SCR had only 40% success so he recommended 3 mm thick allograft, Mihata et al. [18] recommended a graft of 6–8 mm thickness fascia lata as despite that thin graft can decrease peak acromial pressure but only 8 mm thick graft can reduce superior translation, other studies showed better American Shoulder and Elbow Surgeons (ASES) and visual analogue scale (VAS) pain scores with thicker grafts [40], but thicker graft does not always mean better as thicker grafts with post-operative acromiohumeral distance (AHD) more than pre-operative AHD increased graft retear and acromial erosion rates due to friction and overstuffing [41,42].

Using artificial patches have been used recently in reinforcement of cuff repair [43], as SCR with cuff repair [44] or even combination with fascia lata SCR as Ding et al. [45] described the technique of sandwich patch using polyethylene terephthalate which has high tensile strength and high resistance to creep as scaffold interspaced between 2 fascia lata layers to overcome graft creeping and increase graft thickness, other surgeons described another form of combination using LHBT and fascia lata [46] by suturing fascia lata anteriorly to LHBT instead of supraspinatus tendon.

In our technique of SCR, we combine both the fascia lata and the long head of the biceps tendon graft. The advantages of using the biceps long head are its biological availability, and this has been advantageous in getting force vector in glenohumeral articulation when used for augmentation in rotator cuff repairs. Furthermore, biceps is rich in tendon-specific fibroblasts and blood supply, this makes the biceps long head a suitable augment in rotator cuff repair. At present, the biceps long head is being used for SCR as it is readily available [47].

This study aims to retrospectively assess functional and radiological outcomes of hybrid SCR technique using clinical, imaging and functional parameters over a period of 2-year follow-up.

Materials and Methods

A retrospective case series of 11 cases of IRCT underwent hybrid SCR using combined LHBT and fascia lata by single surgeon in Manipal hospitals (Bangalore, India) for a period of 2-year follow-up. Approval from institutional ethical committee bearing number ECR/34/Inst/KA/2013/RR-24 has been obtained, dated May 21st, 2026

We defined irreparable posterosuperior cuff tears as massive tears with severely retracted tendons that cannot be mobilized to their greater tuberosity footprint without tension. We

included cases with irreparable posterosuperior cuff tears regardless the degree of fatty degeneration or atrophy, subscapularis is normal or has repairable tear, LHBT is intact or has partial tear <20% of diameter with intact attachment to superior labrum, normal tone and power of deltoid muscle and normal pre-operative passive ROM.

We excluded cases with irreparable subscapularis tear, complete or partial tear more than 20% of LHBT, abnormal attachment of LHBT to superior labrum, any evidence of arthritis or infection, any axillary nerve palsy or deltoid muscle dysfunction, and restricted passive ROM pre-operatively.

We evaluated the patients post-operatively and compared it with pre-operative records. Clinical examination of these cases focused on active and passive ROM (forward flexion, abduction, internal and external rotation), VAS Pain scores, and ASES were recorded before and after surgery.

The complication rates were evaluated in terms of failure of reversal of pseudoparalysis, graft retear, infection, stiffness, revision, or conversion to reverse shoulder arthroplasty.

Data were collected and student t-test was used by the Statistical Package for the Social Sciences version 24 software; results were expressed as mean ± standard deviation and $P < 0.05$ was considered statically significant [47].

Table 3: AHD, Hamada Grades, ASES, VAS

Case	QuickDASH		ASES		VAS	
	Pre-operative	Post-operative	Pre-operative	Post-operative	Pre-operative	Post-operative
1	80.2	5.4	32	84	5	0
2	76	3.4	40	94	6	2
3	88.4	8.8	54	86	5	1
4	76.2	5.4	60	90	8	0
5	72.4	8.4	34	97	4	0
6	66.8	4.2	30	94	6	0
7	76	11.2	44	86	5	0
8	72.4	6.8	44	92	4	0
9	68.8	3.4	32	88	7	0
10	72.4	46	44	54	5	2
11	76	66	40	30	7	5
Mean	75.05	15.37	41.27	79.55	5.64	0.91
Standard deviation	5.54	19.75	8.99	19.7	1.22	1.51

AHD: Acromiohumeral distance, ASES: American Shoulder and Elbow Surgeons, VAS: Visual analogue scale

Surgical technique

Under general anesthesia with inter-scalene nerve block, patient is positioned in lateral position with the arm in 60° forward elevation, 10° abduction, neutral rotation and shoulder is held on traction by 5 kg.

Diagnostic shoulder arthroscopy by standard posterior portal (2 cm medial and inferior to posterolateral corner of acromion), 4 mm arthroscope is used (Arthrex, Naples, FL), LHBT quality is assessed and if unsatisfactory we proceed with tenotomy and SCR by fascia lata alone, then subscapularis tendon is assessed and if repairable tear is found we repair it before SCR, any other glenohumeral pathology is assessed and addressed if present, then arthroscope is moved to subacromial space through same posterior portal and lateral portal is created 4 cm below mid-point of acromion, complete bursectomy is performed by shaver (Arthrex, Naples, FL) and radiofrequency ablator (Arthrocare; Smith and Nephew, Andover, MA), then we proceed with acromioplasty by Burr (Arthrex, Naples, FL).

Viewing by Wilmington portal and working by lateral portal; posterosuperior cuff is released and mobilized from both bursal and articular sides adequately to incorporate the cuff remnant tissue with both fascia lata and LHBT while performing SCR.

LHBT is traced down in the bicipital groove, the biceps is released and mobilized outside the groove posteriorly, then tenotomy done at necessary length, proximal part is marked with one limb of the suture tape from medial row anchor by cinch fashion with the help of antegrade scorpion suture passer (Arthrex, Naples, FL) and fixed to humerus at foot print of greater tuberosity with multiple half-hitching knots.

Then by using an arthroscopic ruler; anteriorposterior distance between glenoid anchors is measured and anteriorposterior distance between medial row anchors is measured to estimate the fascia lata graft width and 5 mm is added to calculation, then while viewing from Wilmington portal and working by lateral portal; the distance between glenoid to greater tuberosity medial row is measured to estimate length of fascia lata graft

and 15 mm is added to calculation, then fascia lata is harvested and folded on itself and sutured to achieve total graft thickness of 8 mm.

The medial row suture tapes are passed through remnant cuff and parked outside through anterior acromial portal with prior marking of each anchor suture tapes to distinguish them, then 10-cc syringe is passed through lateral portal and all suture tapes are retrieved from this 10-cc syringe but with marking each anchor suture tapes separately to distinguish them, then suture tapes of glenoid anchors are passed through the glenoid side of the graft by scorpion suture passer in the anterior and posterior pre-marked points on the graft, then humeral side suture tapes are passed by similar fashion through the humeral side of fascia lata graft, then graft is passed through the 10-cc syringe into the subacromial space.

In glenoid side; one anterior suture tape is tightened to one posterior suture tape, other suture tapes are pulled to seat the graft on glenoid bed then secured by multiple half-hitch knots, in humeral side; suture tapes of medial row are passed through the remnant cuff and graft then fixed to humeral side in standard double row fashion by two 5.5 mm SwivLock anchors (Arthrex, Naples, FL), then arthroscopic evaluation of graft position and secure fixation over the LHBT central beam.

Results

A total of 17 cases of irreparable posterosuperior cuff tears were enrolled in this cases series, 6 cases were excluded (2 cases with absent or torn LHBT, 4 cases with moderate to advanced arthritis), the remaining 11 cases met the inclusion criteria and underwent hybrid SCR, the mean age was 67.27 years (range, 59–80 years), 2 patients were female and 9 patients were male, the mean follow-up was 24 months ± 2 months.

The mean active forward flexion was improved by 83° increased from 29.09° pre-operatively to 111.82° post-operatively, mean active abduction was improved by 95° increased from 28.18° pre-operatively to 123.64° post-operatively, mean active external rotation was improved by 15° increased from 16.36° pre-operatively to 31.36° post-operatively while mean active internal rotation was improved by 3 levels increased from S1 pre-operatively to D12 post-operatively as shown in Table 1.

No significant changes were recorded in passive ROM, as shown in Table 2.

Our cases had functional improvement on the ASES score by 38.28, with mean ASES score 79.55 pre-operatively improved to 41.27 post-operatively, and pain relief was also improved by 4.73 on VAS pain score from 5.64 pre-operatively to 0.91 post-operatively, as shown in Table 3.

Discussion

Massive IRCT remain a challenging case for orthopedic surgeons, as with loss of coupling forces of rotator cuff muscles and loss of superior capsule; humeral head will migrate superiorly causing impingement, pain, muscle weakness and eventually pseudoparalysis which is a tough situation in relatively young patients without arthritic changes in glenohumeral joint [45].

After Mihata et al. [17,18] description and good clinical outcome that he could achieve with; SCR became a valid option for cases with irreparable posterosuperior cuff tears without arthritis, restoration of superior capsule by fascia lata resulted in decrease superior migration of humeral head and decrease in peak acromial pressure, then SCR was studied with partial repair of remnant cuff tendons and no graft retear was reported in his trial [48] while retear in massive rotator cuff repair was reported as high as 94% [7].

Mihata et al. In a 5-year follow-up study, healed arthroscopic superior capsule reconstruction restored shoulder function and resulted in high rates of return to recreational sport and work. In post-operative graft failure patients, they noted severe cuff tear arthropathy at 5-year follow-up [49].

SCR with LHBT [25] had good and comparable results to SCR with fascia lata while decreasing the cost of medial anchors and operative time with avoidance of donor site morbidity but the limitation of SCR with LHBT that LHBT is not wide enough to cover the anteroposterior width of superior capsule and difficult to achieve side to side repair with infraspinatus which is important factor to achieve good superior stability [48].

Our technique with a combination of fascia lata and LHBT had several benefits: (1) LHBT is a vascular structure with natural medial attachment that may enhance graft healing and provides a scaffold for side-to-side repair of remnant supraspinatus tendon, (2) LHBT diameter is 6.6 mm [29] at the articular margin, which increases the graft thickness and decreases the layers of fascia lata needed in SCR with fascia lata alone, (3) LHBT is anchored laterally with the same anchors of fascia lata without adding cost to the operation, (4) LHBT may become a pain source with rotator cuff progress, so tenotomy may relieve pain generated from tenosynovitis of LHBT, (5) LHBT has a good tensile strength [28], which enables it to become a static depressor of the humeral head during arm elevation, (6) Fascia lata provides the anteroposterior width to cover all the superior aspect of the glenohumeral joint and provides side-to-side repair with infraspinatus, which is difficult in LHBT alone, and (7) Combining fascia lata and LHBT enhances fascia-to-tendon healing.

Our patients had a significant improvement in active ROM,

active forward flexion improved by 83° which was comparable to Mihata et al. [17] SCR by fascia lata alone (64°) and better than Gao et al. [50] SCR by LHBT alone (51 ± 21.7°) while mean active external rotation was improved by 15° in our patients, in SCR with fascia lata alone the improved mean active external rotation was 14° [17] while in SCR with LHBT alone was 21 ± 8.1° [50], mean active internal rotation in our patients was improved by 3 vertebral bodies which was comparable to other studies with 2 vertebral bodies improvement [17] and we think this improvement because of the width of fascia lata and capsular continuity by side-to-side repair with infraspinatus which had be shown to be important factor for superior stability [48].

Pain relief was improved in our study by 5 VAS pain score from mean 4.73 pre-operatively to mean 0.91 post-operatively, also mean ASES score was improved by 38.26 from 79.55 pre-operatively to 41.27 post-operatively, this improvement was comparable to ASES improvement in Mihata et al. [17] SCR fascia lata alone (92.9) at final follow-up and even comparable to Sugaya et al. [51] improvement after rotator cuff repair patients in which ASES score at final follow-up was (94.3), which indicates that Hybrid SCR for irreparable cuff tears can be comparable to cuff repair outcome, while SCR with LHBT alone showed improvement in ASES (87.4 at final follow-up) but it was less score than our study and SCR with fascia lata alone [17], we believe that this improvement in ASES score makes Hybrid SCR a better alternative to reverse shoulder arthroplasty in IRCT.

Sugaya et al. [51] and Mihata et al. [17] explained that the high healing rate is due to several factors: (1) Vascularity of LHBT, which was involved in our technique, (2) Capsular continuity by side-to-side repair with remnant cuff tendons, especially infraspinatus, (3) Proper graft thickness achieved by combining fascia lata and LHBT, and (4) Accurate graft tension by precise measuring of distance from glenoid and greater tuberosity footprint and proper arm position during fixation (30 flexion, 20 abduction and 10 external rotation), which was recommended by Sutter et al. [52].

Cheng et al., retrospectively reviewed unilateral SCR with fascia lata autograft and LHBT augmentation for IRCTs. They compared patients with intact LHBT and those with partial tear. Nine patients had partial tear of graft patch and 2 patients had complete tear showing inferior outcomes [53].

In our study; 2 cases had pseudoparalysis pre-operatively, and both of these cases (100%) improved active ROM with reversal of pseudoparalysis after hybrid SCR procedure, this is comparable to other studies with SCR by fascia lata alone (96%) [19].

2 cases did not achieve the target, out of which 1 developed pseudoparalysis post-operatively and one underwent reverse shoulder arthroplasty.

Limitations of our study are: (1) Small sample size (9 patients), further studies with more patients may improve statistical evidence, (2) Follow-up was only for 2 years, but most of studies showed that graft retear occur within 6 months [17], (3) Retrospective study may produce statistical bias, further prospective cohort studies with direct comparison between our technique and SCR with fascia lata alone or SCR with LHBT alone are suggested.

Conclusion

Hybrid SCR with combination of fascia lata and LHBT is valid choice for IRCT with improved radiological and functional outcome, active ROM and reversal of pseudoparalysis for more than 2-year follow-up.

Clinical Message

This technique provides a viable biological solution for managing irreparable rotator cuff tears and reduce the need for more invasive procedures, such as reverse shoulder arthroplasty. Utilizing the long head of biceps tendon as an augmentation helps enhance graft stability, improves superior humeral head depression, and may reduce graft failure rates. Autologous fascia lata offers a cost-effective and accessible alternative to allografts, particularly in resource-limited settings.

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

Conflict of interest: Nil **Source of support:** None

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