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EDITORIAL

Treatment options for irreparable postero-superior cuff tears in young patients

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Abstract

Rotator cuff tears (RCTs) occur more commonly with advanced age, with most rotator cuff abnormalities in patients less than 30 years old being painful tendinoses or partial-thickness RCTs. Irreparable postero-superior cuff tears has been reported as frequent as 7% to 10% in the general population, and the incidence of irreparable RCTs in young patients is still unknown. Several surgical procedures have been proposed for young patients with irreparable postero-superior RCTs, such as rotator cuff debridement, partial rotator cuff repair, biceps tenotomy/tenodesis, rotator cuff grafting, latissimus dorsi tendon transfer, and reverse shoulder arthroplasty. After being thoroughly investigated in open surgery, arthroscopic techniques for latissimus dorsi tendon transfer have been recently described. They have been shown to be an adequate option to open surgery for managing irreparable postero-superior RCTs refractory to conservative management.

Key words: Postero-superior rotator cuff tears; Young patients; Irreparable; Latissimus dorsi; Tendon transfer

Core tip: Irreparable postero-superior cuff tears have been reported as frequent as 7% to 10% in the general population, and they are challenging, especially in young and active patients. In this patient population, the number of therapeutic options dramatically decreases. Several surgical procedures have been proposed for young patients with irreparable postero-superior rotator cuff tears, such as rotator cuff debridement, partial rotator cuff repair, biceps tenotomy/tenodesis, rotator cuff grafting, latissimus dorsi tendon transfer, and reverse total shoulder arthroplasty. Latissimus dorsi tendon transfer seems to be a viable option to restore function and decrease pain in young and active patients.

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INTRODUCTION

Rotator cuff tears (RCTs) occur more frequently in elderlies, with asymptomatic tears reported in up to 54% of patients aged > 60 years[1,2]. Degenerative tears are more common in the older patient population, whereas more variability can be found in a younger population[3]. In patients 30 years old or younger, rotator cuff tendons are generally healthy, robust, and less likely to be the source of symptoms[4]. Nevertheless, this patient population can be affected by degenerative tears, partial tears of the articular ("PASTA" lesions) side, partial tears of the bursal side, full-thickness tears and lesions secondary to calcium deposits. Eventhough the occurrence of an irreparable RCT is an infrequent condition in young individuals, it represents a significant challenge to the orthopedic and rehabilitation comunity.

For shoulder arthroplasty patients, young has been arbitrarily defined as younger than 55 years[5,6], and no clear definition has been made for rotator cuff patients. After open rotator cuff repair, younger patients (< 55 years of age) have been found 3.5 times less satisfied than older patients (≥ 55 years of age)[7]. Returning to a premorbid state may be more difficult in the younger population because of their increased demands and expectation. Consequently, a clear distinction between younger and older patients undergoing rotator cuff surgery would seem warranted.

The term irreparable RCT is commonly and often inaccurately used interchangeably with the term massive RCT. Indeed, not all massive RCTs are irreparable. Massive RCTs are defined as lesions with a diameter of > 5 cm[8,9] or with the involvement of 2 or more tendons[10,11]. Irreparable tears can be defined in terms of retraction, fatty infiltration, and atrophy of the muscle belly[12]. Diagnostic criteria, usually confirmed by computed tomography (CT) or magnetic resonance imaging (MRI) findings, include stage-3 tendon retraction[13], stage-3 or 4 fatty infiltration[14,15], and stage-3 muscle atrophy[16]. Another important radiographic parameter that may be used to determine whether an RCT is repairable or not is represented by acromiohumeral distance, with an acromiohumeral distance of < 7 mm (*i.e.*, superior migration of the humerus) being associated with decreased likelihood of reparability[17]. Once an irreparable RCT is diagnosed, it can be further classified as follows: Complete tears of the supraspinatus, infraspinatus, and teres minor tendons are postero-superior tears; complete tears of the supraspinatus and subscapularis tendons, sometimes with long head of the biceps tendon involvement, are antero-superior tears[18]. Massive postero-superior RCTs may account up to approximately 40% of the repaired rotator cuff[19] and irreparable postero-superior cuff tears have been reported as frequent as 7% to 10% in the general population[20].

Irreparable RCTs can occur in two physiologically distinct patient groups: (1) patients older than 70 years of age (usually females and less active); and (2) patients in the fifth/sixth decade of life (usually men and higher-demand), with a history of previous rotator cuff repair, chronic rotator cuff injury, or with symptoms of pain and disability after an acute event[18]. Many older patients with irreparable RCTs respond favorably to nonsurgical treatment. Physical therapy is the keystone of treatment in this patient population, with a special focus on deltoid reconditioning[21], strengthening of any remaining cuff tissue, and periscapular strengthening[22]. Nonsteroidal anti-inflammatory drugs (NSAIDs) and subacromial corticosteroid injections may be also used. When patients fail to respond to nonsurgical measures, surgical treatment should be considered and several techniques have been proposed such as rotator cuff debridement[23-25], partial rotator cuff repair[26-28], biceps tenotomy/tenodesis[29,30], rotator cuff grafting[31-36], latissimus dorsi tendon transfer (LDTT)[12,37-45], and reverse total shoulder arthroplasty (RTSA)[46,47] (Table 1). However, it should be considered that most of these techniques are less than optimal for the treatment of young patients with irreparable RCTs.

RTSA

Currently, the RTSA is advocated for patients with[48-50] and without[47,51] glenohumeral arthritis in the presence of an irreparable postero-superior RCT. Irreparable RCTs with pseudoparalysis of anterior elevation are the most favorable indication for RTSA[48]. However, there are concerns regarding the longevity of RTSA and limited possibilities for salvage after implant failure. As a result, RTSA is not used in young and active patients and it is usually reserved for patients above 65 years of age.

Rotator cuff debridement

Debridement of rotator cuff tendon stumps with sub-acromial decompression has been shown to produce good results in patients with low demands (*i.e.*, older, less active patients). However, it has previously been shown that subacromial debridement is much more effective in small tears than in massive tears. Furthermore, debridement has been shown to correlate with progressive joint degeneration, so it has limited role in the treatment of irreparable RCTs, especially in the youngest individuals[48].

Partial rotator cuff repair

Partial repair has been considered a reasonable option in patients with irreparable postero-superior RCTs by providing pain relief and restoring function[23,26]. However, it has been noted that over 50% of patients treated with partial rotator cuff repair had significantly inferior functional outcomes and they had structurally failed using ultrasound[52]. In this light, such option of treatment does not appear suitable in a young pop-

Table 1 Demographic characteristics and clinical outcomes for different surgical options for patients with irreparable postero-superior cuff tears

		Age (yr)	FU (mo)	Constant	DASH	UCLA	ASES	JOA	WORC
RCB	Berth *et al*[23]	64.3 (60-72)	24.7 (21-28)	50.4 ± 15.3	35.3 ± 18.6	nr	nr	nr	nr
	Gartsman *et al*[24]	62.0 (42-77)	63.2 (48-117)	52.4 (nr)	nr	20.8 (nr)	55.3 (nr)	nr	nr
	Melillo *et al*[25]	60.0 (36-79)	nr	nr	nr	19 (nr)	nr	nr	nr
PRCR	Berth *et al*[23]	62.5 (60-67)	23.8 (21-28)	72.8 ± 16	23.8 ± 16.8	nr	nr	nr	nr
	Kim *et al*[27]	62.3 (54-72)	41.3 (36-52)	74.1 ± 10.6	nr	25.9 ± 5.0	nr	nr	nr
	Wellman *et al*[28]	65.0 (48-79)	47.0 (13-103)	71.0 (nr)	nr	nr	nr	nr	nr
BT/T	Boileau *et al*[29]	68.0 (52-85)	71 ± 6	66.5 ± 16.3	nr	nr	nr	nr	nr
	Walch *et al*[30]	64.3 (39-81)	57.0 (24-168)	67.6 ± 14.7	nr	nr	nr	nr	nr
RCG	Audenaert *et al*[31]	67.0 (51–80)	43.0 (24–86)	72.1 (34–89)	nr	nr	nr	nr	nr
	Bond *et al*[32]	54.4 (39-74)	26.7 (12-38)	84.0 (68–100)	nr	30.4 (22–35)	nr	nr	nr
	Mihata *et al*[33]	65.1 (52-77)	34.1 (24-51)	nr	nr	32.4 ± 4.3	92.9 ± 11.3	92.6 ± 9.0	nr
	Sclamberg *et al*[34]	67.5 (52-79)	nr (6 to 10)	nr	nr	nr	58.4 (30-95)	nr	nr
	Wong *et al*[35]	53.6 (39-67)	nr (24-68)	nr	nr	27.5 (nr)	84.1 (nr)	nr	75.2 (nr)
LDTT	Aoki *et al*[37]	64.0 (48-82)	35.6 (26-42)	nr	nr	28.0 (11-35)	nr	nr	nr
	Castricini *et al*[38]	60.0 (46-67)	27.0 (24-36)	74.0 (40-84)	nr	nr	nr	nr	nr
	Habermeyer *et al*[41]	61.0 (47-76)	32.0 (19-42)	74.6 (64.5-81.5)	nr	nr	nr	nr	nr
	Lehmann *et al*[42]	64.0 (41-78)	24.0 (12-41)	70.0 (27.0–98.0)	nr	nr	nr	nr	nr
	Zafra *et al*[44]	54.0 (37–72)	28.0 (12–58)	70.25 (55–85)	nr	nr	nr	nr	nr
	Grimberg *et al*[45]	62.0 (31-75)	29.4 (24-42)	65.4 ± 12.1	nr	nr	nr	nr	nr
	Paribelli *et al*[57]	62.5 (45–77)	32.0 (12-60)	nr	nr	30.3 ± 4.2 (29-34)	nr	nr	nr
RTSA	Ek *et al*[46]	60.0 (46-64)	93.0 (60-171)	74.0 (31-100)	nr	nr	nr	nr	nr
	Mulieri *et al*[47]	71.0 (52-88)	52.0 (24-101)	nr	nr	nr	75.4 (25-100)	nr	nr

Range in parenthesis. FU: Follow-up; ±: Standard deviation; nr: Not reported; RCB: Rotator cuff debridement; PRCR: Partial rotator cuff repair; BT/T: Biceps tenotomy/tenodesis; RCG: Rotator cuff grafting; LDTT: Latissimus dorsi tendon transfer; RTSA: Reverse total shoulder arthroplasty; Constant: Constant-Murley Shoulder Outcome score; DASH: Disabilities of the Arm, Shoulder and Hand score; UCLA: University of California-Los Angeles Shoulder scale; ASES: American Shoulder and Elbow Surgeons score; JOA: Japanese Orthopedic Association score; WORC: Western Ontario Rotator Cuff Index.

ulation with irreparable RCTs.

Biceps tenotomy

Severe pain or dysfunction caused by an irreparable RCTs associated with a biceps lesion can be effectively treated with arthroscopic biceps tenotomy or tenodesis. Relief of pain has been reported in 85% of patients who had undergone an arthroscopic tenotomy of the long head of the biceps tendon for the treatment of an irreparable RCT, with no effect on strength or range of motion[30]. However, the tenotomy of the biceps tendon may not represent the solution to menage irreparable RCTs of young and active patients that have much higher expectations of functional outcomes from their shoulder surgery. In addition, severe rotator cuff arthropathy and pseudoparalysis represent contraindications to this procedure[29].

Rotator cuff grafting

Issues to be considered when contemplating using rotator tendon grafting materials should be the cost, the extra operative time required to place the material, and the potential morbidity of the grafting material[53]. Whereas promising early results have been reported[32,35], there is definitive evidence that some materials (*e.g.*, porcine small intestine submucosa) are detrimental[36].

Latissimus dorsi tendon transfer

In this light, irreparable postero-superior RCTs associated with functional impairment of the shoulder are challenging, especially in young and active patients. In this patient population, the number of therapeutic options dramatically decreases and tendon transfers seem to be a reasonable solution to restore function and decrease pain[18,48,54]. Tendon transfers are not indicated for older, more debilitated patients since the amount of muscle reeducation has been shown to determine, at least in part, the amount of success[18].

Several authors have investigated techniques to perform the LDTT in open surgery, reporting overall good results[12,37,39,41,42,44]. LDTT was first described in patients with brachial plexopathies causing loss of external rotation. Gerber *et al*[55] first used LDTT to improve shoulder external rotation in younger patients with irreparable postero-superior RCTs. The authors reported good to excellent results after this procedure. Since then, similar results have been reported by several other studies[12,37,39,41,42,44]. However, proper patient selection is crucial with this procedure. Factors associated with poor outcome include subscapularis and/or deltoid dysfunction, osteoarthritis of the glenohumeral or acromioclavicular joint, and loss of teres minor function[12,56].

Recently, to preserve the deltoid muscle arthroscopic techniques for LDTT have been described[40,43]. To the best of our knowledge, there are only three reports published on arthroscopic-assisted LDTT for irreparable RCTs[38,45,57].

Castricini *et al*[38] reported on 27 patients with a mean age of 60 years (range 46 to 67 years) with irreparable postero-superior RCTs associated with shoulder fun-

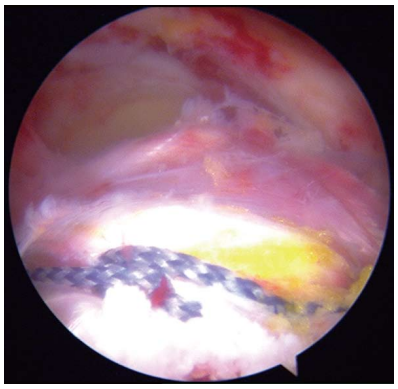

Figure 1 Intra-articular view from the lateral portal showing the fixation of the latissimus dorsi tendon to the greater tuberosity.

ctional impairment treated with arthroscopic-assisted LDTT (Figure 1). The authors showed a significant improvement in the mean Constant and Murley score, pain score, muscle strength in forward elevation, and range of motion in external rotation ($P < 0.05$) at a mean follow-up of 27 mo. The authors used a true anteroposterior radiograph to evaluate the grade of osteoarthritis in the shoulder pre- and postoperatively according to the Samilson and Prieto three-stage classification system[58]. They also assessed the proximal migration of the humeral head on true anteroposterior radiographs in neutral rotation, using a three-stage classification (stage 1, no proximal migration; stage 2, mild proximal migration; stage 3, severe proximal migration). MRI was performed preoperatively to evaluate the rotator cuff tendon tear and muscle quality. MRI was not performed postoperatively at any follow-up visit. The authors did not report significant osteoarthritis progression and proximal migration of the humeral head after surgery.

Grimberg *et al*[45] evaluated the clinical (Constant score and Subjective Shoulder Value), radiologic (acromiohumeral distance), and MRI (transferred tendon aspect) results of arthroscopic-assisted LDTT performed in 55 patients with a mean age at the time of surgery of 62 years (range 31 to 75 years) with irreparable postero-superior RCTs. The patients were evaluated at a mean follow-up of 29 mo. The authors reported statistically significant improvement in Constant score, Subjective Shoulder Value, and range of motion ($P < 0.001$) from preoperatively to postoperatively. All patients underwent a preoperative radiologic evaluation of the shoulder with assessment of the subacromial space and the grade of glenohumeral arthrosis according to the Hamada classification[59], as well as a CT arthrogram or MRI with assessment of atrophy and/or fatty infiltration of the subscapularis, supraspinatus, infraspinatus, and teres minor according to Fuchs *et al*[14], Goutallier *et al*[15] and Thomazeau *et al*[16]. The postoperative radiologic evaluation comprised: (1) an immediate postoperative MRI; (2) an MRI at a minimum of 1 year postoperatively to assess the integrity of the transferred tendon; and (3) standard radiographs at maximum follow-up. The authors did not report any statistical difference in acromiohumeral distance and osteoarthritic stage between preoperative and final follow-up. However, four patients had a ruptured latissimus dorsi tendon on MRI at 1 year follow-up.

Paribelli *et al*[57] compared clinical results [University of California Los Angeles (UCLA) shoulder rating scale, ROM, measurement of the strength and the rotator cuff quality of life (RC-QOL) questionnaire] in two groups of patients with irreparable RCTs treated surgically: one group (20 patients) received an arthroscopic-assisted LDTT, and the other (20 patients) an arthroscopic partial rotator cuff repair. The patients were evaluated at a mean follow-up of 2.8 years (1-5, SD 3). The authors reported statistically significant improvement ($P < 0.05$) in UCLA score results, strength and RC-QOL questionnaire for patients treated with arthroscopic-assisted LDTT compared to patients treated with arthroscopic partial rotator cuff repair, with no differences found between groups for pain relief. One case of latissimus dorsi tendon rupture was reported (13 mo after surgery) and the patient underwent a reverse total shoulder arthroplasty surgery.

Procedures other than arthroscopic-assisted LDTT have been proposed and are currently accepted as viable symptomatic options. In light of recent publications[38,45,57], there is growing interest in arthroscopic-assisted LDTT techniques for the treatment of young patients with irreparable postero-superior RCTs. There is a need for more long-term, well-conducted studies to confirm the efficiency of this technique for relieving pain and improving function in young patients with postero-superior cuff deficiency and to determine whether arthroscopic-assisted LDTT can be the treatment of choice in this patient population.

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