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Current concepts in the primary management of irreparable posterosuperior rotator cuff tears without arthritis

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- Various procedures exist for patients with irreparable posterosuperior rotator cuff tears (IRCT). At present, no single surgical option has demonstrated clinical superiority.
- There is no panacea for treatment and patients must be aware, in cases of palliative or non-prosthetic options, of an alarming rate of structural failure (around 50%) in the short term.
- The current review does not support the initial use of complex and expensive techniques in the management of posterosuperior IRCT.
- Further prospective and comparative studies with large cohort populations and long-term follow-up are necessary to establish effectiveness of expensive or complicated procedures such as superior capsular reconstruction (SCR), subacromial spacers or biological augmentation as reliable and useful alternative treatments for IRCT.

Keywords: shoulder; irreparable rotator cuff tears; latissimus dorsi transfer; partial repair; subacromial spacer interposition; biceps tenotomy; superior capsular reconstruction; reverse arthroplasty

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Introduction

One of the most challenging issues in shoulder surgery is the management of symptomatic irreparable rotator cuff tears (IRCTs). The literature reports that 12% of posterosuperior rotator cuff tears are irreparable.[1] The latter condition, when symptomatic, can be managed with several approaches without clear evidence-based guidelines. For example, the same patient with a D-type IRCT, according to the classification by Collin et al[2] (Fig. 1), may be offered physiotherapy, partial repair, tendon transfer, superior capsular reconstruction (SCR), subacromial spacer (balloon) or even a reverse shoulder arthroplasty (RSA) depending on multiple factors, including: geography, surgeon experience, implant costs, etc. Moreover, even if it is reported that these surgical procedures have different indications, they are often applied to patients with similar problems indiscriminately.

Several articles have been published recently on the management of posterosuperior IRCTs.[3-6] This article provides a comprehensive review of current concepts pertaining to IRCT, including a contemporary definition and classification of this lesion, a review of pertinent biomechanical changes induced by this condition and clinical and radiological evaluations. Lastly, as there is no current 'benchmark' for their management, the aim of this review is to present a critical analysis of current options based on the authors' personal experiences and recent available scientific literature.

Biomechanics

Normal shoulder kinematics and function are the result of the synergistic action of the muscles of the rotator cuff and the deltoid. These muscles act as a dynamic stabilizer by providing a centralizing force in the glenohumeral joint and allow for normal shoulder function. However, in the setting of an IRCT with rotator cable disruption and non-compensation by other humeral head stabilizers (i.e.

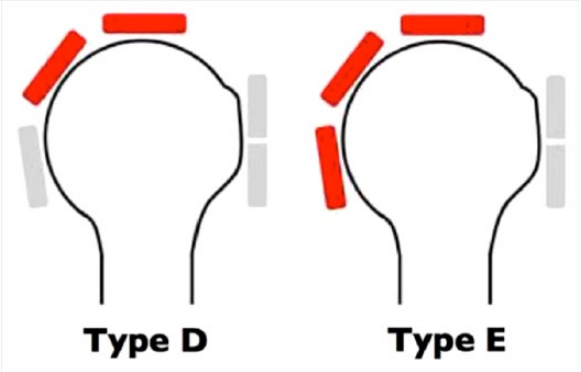

Fig. 1 The rotator cuff is divided into five components: supraspinatus, superior subscapularis, inferior subscapularis, infraspinatus and teres minor. Rotator cuff tears are classified by the involved components: type D, supraspinatus and infraspinatus tears; and type E, supraspinatus, infraspinatus and teres minor tears. From Collin et al,[2] reproduced with permission.

pectoralis major and latissimus dorsi), the moments created by the opposing muscular forces are insufficient to maintain equilibrium in the coronal plane, resulting in altered kinematics, instability and ultimately pseudoparalysis and arthritis. Interestingly, only few patients with an IRCT developed pseudoparalysis and arthritis.[2] This finding has at least two potential explanations. First, the subscapularis that may not be involved in these tears is the key factor for active forward flexion.[2] Second, the rotator cable, a thickening of the rotator cuff that is supported by pillars, has an intact anterior attachment which is important for elevation. This may explain why patients can maintain active mobility, and also why even after only a partial rotator cuff repair, good functional results can be achieved.[7] Consequently, all the conditions for an imbalance in the force couples are not always met and subsequently loss of function is only occasionally seen.

Definition of an IRCT and clinical and imaging findings

The definition of an irreparable rotator cuff varies widely. Furthermore, with advances in anchors, suture strength, techniques of release and repair with load-sharing ripstop fixation[8] etc, the definition continues to evolve. Two situations can occur: the first one consists of a patient who has a contraindication to cuff repair, and the second scenario is intraoperative when a complete repair is not physically possible. While most rotator cuff tears can be repaired,[1] some lesions are not repairable or should not be repaired.[9] Imaging studies play a critical role in preoperative assessment, evaluation of the defects and selection of the correct treatment for an IRCT. The following clinical and radiological preoperative factors that have been clearly associated with postoperative clinical or radiological failure should be considered before attempting repair.

Clinical examination

Pseudoparalysis was defined as a chronic inability to actively elevate the arm beyond 90° with full passive forward flexion.[10] It is nevertheless important to note that this corresponds to a functional limitation sometimes associated with an anterosuperior escape and not just to pain inhibition. Several studies purport to reverse pseudoparalysis although they represent mainly pseudoparesis cases. When pain inhibition or slight stiffness limits the patient from elevating the shoulder, the limited movement is not secondary to complete cuff deficiency.[11] We agree with Burks and Tashjian[12] who proposed that pseudoparalysis is chronic and that essentially atraumatic forward flexion limited to up to 45° is typically represented in the 'shrug sign'. Anatomically, pseudoparalysis requires the disruption of at least one rotator cable attachment; in Collin et al's[2] study this was found in only 2.9% of massive D-type cases. This means that pseudoparalysis of the posterosuperior rotator cuff usually involved the whole of the posterior cuff (33.3% of pseudoparalysis found in E-type IRCT). In addition to pseudoparalysis, the presence of lag signs (external rotation lag, drop, dropping, hornblower signs)[13] is also associated with non-reparability.[14]

Radiographs

Radiographs are mandatory in determining the morphology and status of the glenohumeral joint to exclude glenohumeral arthritis. A decreased acromiohumeral distance < 7 mm in a standard anteroposterior radiograph indicates superior migration of the humeral head which increases the probability of finding an irreparable cuff tear. Such distance is correlated with: tears of the infraspinatus that mainly acts in lowering the humeral head[15] and varying degrees of fatty infiltration.[16] Nevertheless, such criteria should be interpreted with great care. First, it is difficult in clinical practice to obtain standardized radiographs, making measurement imprecise. Second, this distance has not been associated with an inability to obtain an intraoperative complete repair of the supraspinatus (18.2% irreparable, odds ratio (OR) = 0.55, p = 0.610).[1] At the end of the spectrum, acetabularization of the acromion and femoralization of the humeral head are preoperative adapting factors reflecting significant chronic static superior instability and are a contraindication for repair.

Ultrasonography, MRI and CT

Following radiographic evaluation, advanced imaging modalities are obtained to confirm and plan treatment. Ultrasonography is an excellent cost-effective screening tool in the office but does not allow evaluation of

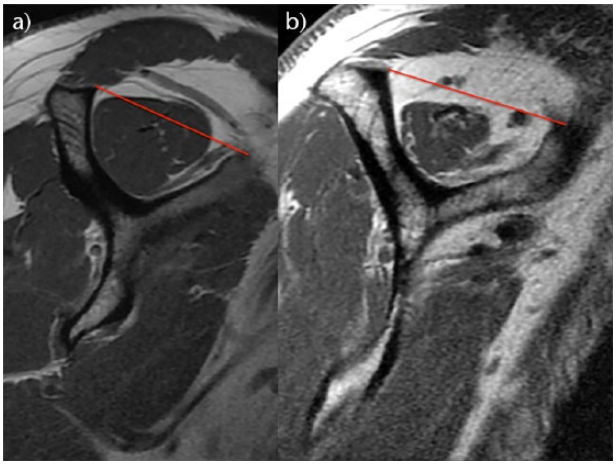

Fig. 2 The 'tangent' sign is used on sagittal images. A is a line (in red) which is drawn at a tangent to the superior border of the scapular spine and the superior margin of the coracoid on the most lateral image where the scapular spine is in contact with the scapular body: a) negative tangent sign; b) positive tangent sign.

intra-articular pathology or precise evaluation of muscle quality. MRI accurately estimates tear pattern, fatty infiltration, tendon length and retraction, and is thus obtained to plan repair or reconstructive surgeries. The muscle bellies of the rotator cuff are assessed, if available, on T1-weighted axial, coronal and sagittal views with cuts sufficiently medial on the scapula to allow proper assessment regardless of retraction. Finally, CT scans are used if MRI is contraindicated or if joint arthroplasty is planned, particularly in the setting of glenoid deformity. Additionally, CT scan can be conducted with intra-articular contrast to assess the cuff. It should be noted that the MRI and CT are not reliable when analyzing the acromiohumeral distance as they are performed in the lying position.

The most important negative prognostic factor is high-grade fatty infiltration of the rotator cuff muscle bellies (Goutallier grade 3 or 4 fatty infiltration). Fatty infiltration is irreversible even with repair and leads to reduced function of the rotator cuff musculature.[17] Inability to obtain a complete repair of the supraspinatus is associated with Goutallier[18] grade 3 to 4 fatty infiltration of the supraspinatus (43% irreparable) *versus* grade 0 to 2 fatty infiltration (6% irreparable, OR = 11.8, p = 0.001).[1] Moreover, if on MRI the preoperative supraspinatus tendon length is < 15 mm, rotator cuff tears with Goutallier grade 2 to 3 fail to completely heal in up to 92% of cases.[19]

Atrophy

The presence or absence of supraspinatus atrophy is determined using the 'tangent sign' of Zanetti et al[20] (Fig. 2). This sign is an indicator of advanced fatty infiltration[21] and has been reported to be a predictor of whether a rotator cuff tear will be repairable.[22] In a recent study, Sheean et al[1] found that inability to obtain a complete repair of the supraspinatus was associated with a positive tangent sign (30% irreparable) *versus* a negative tangent sign (6.3% irreparable, OR = 6.3, p = .0102).[1] Supraspinatus atrophy can also be determined according to the Thomazeau classification.[23] Agreement for this classification is, however, fair (intraobserver kappa = 0.51 and interobserver kappa = 0.30) and its use cannot be recommended as a criterion of reparability.[24]

Treatment

Nonoperative treatment

As patients with posterosuperior IRCT do not have anterosuperior escape, many respond favourably to non-surgical treatment which should be attempted for six months before considering surgery. If after this adequate time period symptoms have not improved, the chances of success with further nonoperative treatment decreases and operative treatment may be considered.

The mainstay of non-operative treatment includes non-steroidal anti-inflammatory drugs, subacromial corticosteroid injections and physiotherapy. Levy et al[25] prospectively assessed 17 patients with clinically and radiographically diagnosed IRCTs that underwent an anterior deltoid training programme. By nine months, the mean Constant score had improved from 26 to 63, and the forward flexion improved from 40° to 160°. In another prospective cohort of 45 patients suffering from pseudoparalysis with a radiographically confirmed D-type rotator cuff tear, Collin et al[26] found after a follow-up of 48 months that 14 of 15 patients had substantial improvement in active forward elevation to above 90°.

The protocol of rehabilitation focuses habitually on a multimodal physiotherapy programme with global deltoid reconditioning and periscapular strengthening.[27] Certain authors proposed that re-education of the anterior deltoid muscle to compensate for a deficient rotator cuff is the cornerstone of successful nonoperative treatment.[25] The promising results have nevertheless not been confirmed.[28] This is the reason why we attach more importance to solicitation of stabilizing muscles of the glenohumeral joint with an approach based on exercises in a high position. In this position, the deltoid, which acts synergistically with the remaining rotator muscles, has no upward component and participates in the articular coaptation.[26] Such a rehabilitation programme is designed to achieve five objectives:

1) to relieve the pain and muscle tension in the scapular and neck area in order to restore mobility of the scapula on the rib cage, thereby ensuring proper glenoid position during active movements. The

muscles targeted are the pectoralis minor, upper trapezius and levator scapulae;
2) to correct false humeral head centring (superior, anterior and rotational displacements) in order to optimize scapula-humeral mobility. Gentle manual recentring techniques promote the restoration of arthroceptive and biomechanical conditions that allow the intact rotator cuff muscles to fulfil their stabilizing function during shoulder elevation;
3) to strengthen the muscles that stabilize and move the shoulder, in order to eliminate lower trapezius dyskinesia, thereby correcting the anterior tilt of the scapula; to strengthen the upper portion of the serratus anterior muscle, in order to ensure optimal glenoid position during anterior arm elevation; and to strengthen the intact rotator cuff muscles with special emphasis on the external rotator (teres minor) and on the coaptation role of the deltoid when the arm is elevated;
4) to work the muscles that stabilize the glenohumeral joint by performing exercises with the arm elevated. In this position, the deltoid muscle, which acts synergistically with the intact rotator cuff muscles, does not elevate the arm and contributes to coaptation of the glenohumeral joint;
5) to recover proprioception and movement automatism via neuro-motor rehabilitation targeting movement integration. Patients with shoulder pseudoparalysis often underuse their shoulder, thereby deactivating the motor programmes used in everyday activities. Vision plays a crucial role in these exercises. The patient should look at the object to be reached then concentrate on the hand, keeping the eyes on it without paying attention to the fact that the shoulder moves also. Thus, the hand is used to rehabilitate the shoulder. Initially, bilateral symmetrical movements may be easier to perform, as motor commands are then coupled via inter-hemispherical cerebral communication.[26]

Surgical treatment

In the absence of a benchmark surgical solution, treatment of IRCTs has proven to be quite challenging, adding to the surgeon's dilemma regarding the patient and treatment options. Younger active patients (< 60 years of age) with traumatic tears may be immediate candidates for surgery based on the high risk for progression with conservative treatment.[29] Surgical approaches have been advocated, with varying degrees of success. The surgical options include arthroscopic debridement, partial repair, biceps procedure, SCR, muscle transfers,[30] biodegradable subacromial spacer interposition,[31] biological augmentation and RSA.[32] Despite all these options, IRCTs are difficult to manage and treat effectively. There are no high levels of evidence prospective trials comparing these various options and therefore recommendations are mainly based on retrospective case series, surgeon experiences and expert opinions.

Long head of the biceps tenotomy or tenodesis +/- partial repair

This procedure includes biceps tenotomy or tenodesis, partial repair if evaluation has deemed the remaining tendon to be of good quality and associated procedures such as distal clavicle resection if necessary. Tenotomy or tenodesis of the long head of the biceps should be performed consistently, as biceps tendinopathy is observed in 92% of rotator cuff lesions.[33] There is evidence suggesting that this structure is a source of pain and contributes to the symptomatology of patients with an IRCT.[34-36] Walch et al[36] reported statistically significant improvements in the Constant score with an isolated biceps tenotomy (Constant score[37] 48 points preoperatively to 68 points at follow-up ($p < .0001$)) which has been confirmed by numerous authors.[34,35,38,39]

The aim of this procedure is to repair all of the rotator cuff tendon that can reasonably be brought back to the tuberosities without excessive tension, and to address all potential causes of persistent pain or factors threatening the repair. The goal of a partial repair is to restore force couples,[40] to re-establish the 'suspension bridge'[41] and to prevent secondary extension of the tear. In this procedure, complete closure of the defect is less important than restoration of a stable fulcrum for normal shoulder kinematics. Although having little effect on improvement in shoulder strength after this intervention, eliminating various pain generators usually enhances function. Although a partial cuff repair is conducted, the role of the biceps tenotomy should not be overlooked in the patient improvements observed.[34] Acromioplasty is not advisable in the setting of an IRCT as it may lead to postoperative anterosuperior migration of the humeral head. Tuberoplasty has been proposed as an alternative to classic subacromial decompression in order to preserve the integrity of the coracoacromial arch.[42] Although the results in compensated tears and low-demand patients are promising,[43] it is currently unknown if the positive effect with regards to pain relief is due to the tuberoplasty or to the concomitant performed bursectomy, synovectomy and biceps treatment.

Partial repair provides good clinical outcomes, comparable with those reported with biceps sacrifice and subacromial decompression. The main purported benefit of repairing part of the cuff is its potential to slow or halt further tear progression and to increase the strength of the shoulder. All series of partial repair reported a significant improvement in functional scores,[38,44-50] while reporting a rate of radiological repair failure around 50%

Table 1. Results of partial repair of irreparable rotator cuff tear

Authors	Year	Study type	Shoulders (n)	Mean follow-up	Mean preoperative score	Mean postoperative score	p-value	Radiological failure rate (%)
Berth et al [42]	2010	Prospective	21	24	30†	41†	<.01	52
Chen et al[48]	2017	Retrospective	37	30	46‡	79‡	<.001	42
Cuff et al.	2016	Retrospective	28	71	47‡	79‡	<.001	NA
Galasso et al[50]	2017	Retrospective	95	84	39†	76†	<.001	NA
Godeneche et al[51]	2017	Prospective	23	41	32†	75†	<.001	48

†Constant score; ‡ASES score; NA, none available.

(Table 1).[38,44,45,47,48] Long-term benefit in prevention of head migration has not been demonstrated.

Tendon transfer

Tendon transfers have been described in the management of an IRCT; however, the outcomes reported have been inconsistent. The results of new transfers involving the lower trapezius have not been well described with mainly anatomical or biomechanical data[51] and will not be described in this review article. L'Episcopo and latissimus dorsi transfer (LDT) are reported to reconstitute the posterior force couple.

L'Episcopo first described the technique of transfer of the latissimus dorsi and teres major tendons in children with obstetric palsy.[52] The procedure involves transferring both tendons laterally and posteriorly on the humerus, such that the function of the transfer changes from internal to external rotation. Boileau et al[53] recently analysed 26 patients (two with glenohumeral arthritis) and found a gain in active external rotation of 26° and an improvement in adjusted Constant score from 63.6% to 86.9% ($p < .001$). The integrity of the remaining internal rotators is of utmost importance as patients after a L'Episcopo transfer lose significant internal rotation and may not be able to reach their back anymore.

LDT has been proposed for IRCT as an open procedure to improve control of external rotation in young and high-demand patients with an intact subscapularis.[54] Namdari et al[57] found in a review that patients followed for a mean of 46 months had a mean adjusted Constant score of 46 preoperatively compared with 73 postoperatively ($p < 0.001$). The mean active external rotation improved from 17° to 27° which is statistically significant ($p < 0.001$) but not clinically significant. As proposed by Gerber et al,[55] isolated LDT with or without RSA is mainly to 'restore control of external rotation in selected patients' rather than active external rotation itself. It is also important to keep in mind that the results of the open technique are superior in case of an intact or repairable subscapularis and a hypertrophic teres minor.[56,57] In other words, LDT in D-type IRCTs is efficient but only indicated in selected patients who have an isolated loss of external rotation, a preserved forward elevation above 90°, an intact or repairable subscapularis and ideally a hypertrophic teres minor. Conversely, LDT gives unpredictable results in E-type LDT and potentially a L'Episcopo transfer is superior in those cases. Recently, indications and techniques have evolved and arthroscopic procedures have been proposed to hopefully limit humeral head upper migration and to restore anterior active elevation.[58] The same group observed in a prospective series of 25 patients with a follow-up of 12 months an improvement in mean Constant score from 44 points preoperatively to 65 postoperatively, a slight improvement (10°) in external rotation but a radiological failure rate of 43%.[39]

SCR

SCR with either fascia lata autograft,[59] dermal allograft patch[60] or long head of the biceps[61] is a solution that can prevent superior humeral head migration and restore the shoulder muscle force couples. The superior capsule is believed to be important in maintaining humeral head depression and compensating for the dynamic effect of the rotator cuff muscles. However, the superior capsule is an inconsistent structure constituted by a confluence a various ligaments, that is in continuity in only 27% of the cases.[62] No articles have reported on the mid- or longer-term clinical and radiological results. Mihata et al[59] found, in a small series of 23 patients using fascia lata autograft at a mean follow-up of 34 months, an increase in forward flexion from 84° to 148° ($p < .001$) and that external rotation increased from 26° to 40° ($p < .01$). A total of 20 patients (83%) at the most recent follow-up had an intact graft without re-tear. Denard et al[63] reported, in a series of 59 patients using a dermal allograft with a minimum follow-up of one year, an increase in forward flexion from 130° pre-operatively to 158° postoperatively, an improvement in ASES score from 44 to 78 and a 55% failure rate. In all cases, a biceps tenotomy or tenodesis was performed.

Subacromial balloon interposition

The biodegradable spacer (balloon shape) is arthroscopically implanted between the acromion and the humeral head. The subacromial spacer has been designed to create a physical barrier between tissues in the subacromial space and keep the humeral head depressed when the rotator cuff is not sufficient to facilitate deltoid action, thus

Table 2. Results of the different techniques of irreparable rotator cuff tear treatment from representative series

Authors	Year	Study type	Shoulders (n)	Mean age (yrs)	Mean follow-up	Mean preoperative score	Mean postoperative score	p-value	Radiological failure rate (%)
Biceps tenotomy									
Walch et al[36]	2005	Retrospective	307	64	57	48†	67†	< 0.001	0
Partial repair									
Godeneche et al[47]	2017	Prospective	23	59 (entire series)	41	32†	75†	< 0.001	48
LDT									
Kany and Grimberg[39]	2017	Prospective	25	65	12	44†	65†	< 0.001	43
SCR									
Denard et al[70]	2017	Prospective	59	62	12	44‡	76‡	< 0.001	55
Subacromial spacer interposition									
Deranlot et al[63]	2017	Retrospective	39	70	33	45†	76†	< 0.001	100 (biodegradable balloon)
Biological augmentation									
Scheibel et al[42]	2007	Prospective	23	60	14	52	81	< 0.001	20
RSA									
Ernstbrunner et al[68]	2017	Retrospective	23	57	140	24†	59†	< 0.001	-

†Constant score; ‡ASES score; NA, none available.

permitting improvement in glenohumeral joint movement with significant pain reduction. At five-year follow-up, a recent study on the subacromial spacer with an associated biceps tenotomy reported that 85% of the patients showed a clinically significant improvement of at least 15 points in Constant score,[37] while 62% showed at least 25 points of improvement.[31] Deranlot et al[64] described, in a series of 37 patients (39 shoulders), a significant improvement of the Constant score from 45 preoperatively to 76 at a mean of 33 months follow-up. In their study, 92% of the shoulders also underwent a long head of biceps tenotomy.

Biological augmentation

These techniques involve using a graft (allo-, auto- or xenograft) or synthetic patch to bridge the defect in the rotator cuff and improve the connection of the tendon remnant at least at the border of the original footprint. During this procedure, the torn rotator cuff tendons are released, mobilized, and undergo a partial repair. The graft is then sutured on top of the residual defect between the lateral margin of the medial fixed rotator cuff tendon and its native insertion site on the lateral footprint and humerus. A recent systematic review confirms that this approach improved function with a high rate of structural integrity rates on MRI at 12-month minimum follow-up.[65]

RSA

RSA has emerged as a treatment for IRCT. Two recent systematic reviews confirmed that this is a reliable procedure to improve mobility and strength, producing an improvement in pain and postoperative outcome scores.[66,67] Moreover, RSA yielded benefits considered cost-effective when compared with other treatments, especially in elderly patients with IRCT.[4] RSA should be considered in older patients for whom a long period of immobilization and rehabilitation is undesirable.[32] Even if the rate of complications was high in the two systematic reviews,[66,67] a dramatic decrease has been observed with new designs and better techniques.[68] Recently, the complication rate has been reported to be lower.[32] However, caution should still be exercised when offering RSA to young patients who are often disappointed by the results.[69,70]

Discussion and preferred paradigm treatment for IRCT

There are many treatment options for IRCTs. In general, nonoperative management with physiotherapy, pain management, activity modification and possibly injections should be conducted first. In patients that fail nonoperative means, surgery may be considered depending on the patient's age, activity, physical examination, degree of fat infiltration and degree of arthritis. Unfortunately, no single procedure has demonstrated consistent clinical superiority as several options have shown similar results for similar groups of patients (Table 2).

Firstly and presently, there is no high-quality literature that demonstrates that partial repair, LDT, SCR, biological augmentation and subacromial spacer interposition result in better outcomes than a biceps tenotomy. A recent meta-analysis showed that no surgical procedure was substantially better than a biceps procedure. Therefore, the fact that patients regain function after surgery points towards the potential effect of pain-related muscle activity inhibition after biceps tenotomy. Second, despite the growing interest in the use of SCR, biological augmentation and subacromial spacer interposition, their price

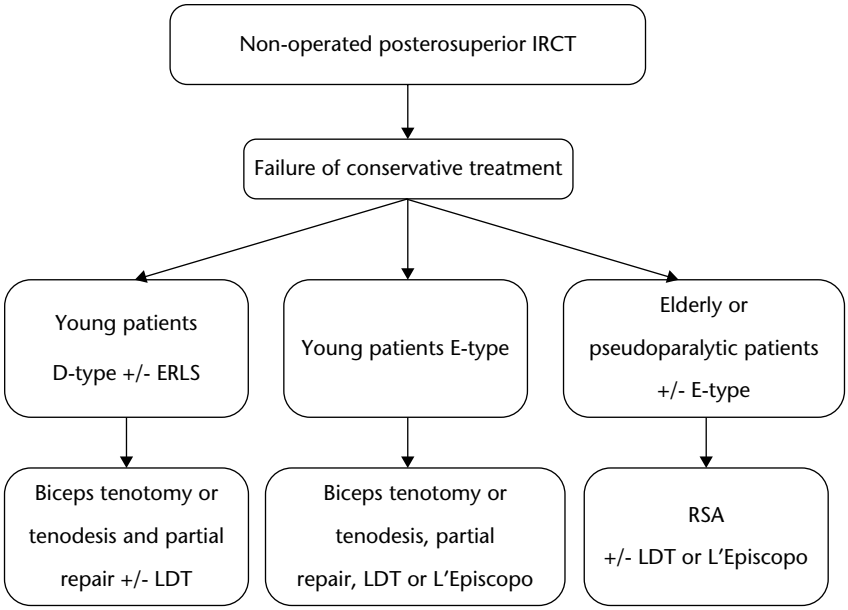

Fig. 3 Treatment paradigm proposed by the authors for patients with irreparable rotator cuff tear (IRCT) (LDT, latissimus dorsi transfer; RSA, reverse shoulder arthroplasty).

remains a potential issue in terms of socioeconomic aspects. Third, autograft application in SCR and LDT have a considerable risk of complications and morbidity related to the donor site. Fourth, unpredictable results do not justify the morbidity of sling immobilization, months of physiotherapy and missed time from work that are often necessary following the different options.

Outcome results may vary and directly rely on careful patient selection while underlying pathology must be taken into consideration. Except for isolated tenotomy of the long head of the biceps and for RSA, patients should be able to withstand and comply with long rehabilitation protocols, as well as be informed of the benefits expected following surgery and the rate of structural failure (around 50% for all reconstructive techniques). In this context, patient expectations should match anticipated results. Unfortunately, the scientific literature does not contain enough data to allow establishment of an evidence-based treatment algorithm. Treatment is based on patient factors and associated pathology as previously discussed and therefore includes personal experience and scientific data. The following criteria have proven helpful in the assessment of the key parameters in the decision-making process for posterosuperior IRCT in our experience and are offered for consideration.

As most D-type IRCTs have a good evolution without surgery,[26] non-surgical treatments including non-steroidal anti-inflammatory drugs, subacromial corticosteroid injections and physiotherapy should be attempted for six months before considering surgery. If the patient has an active forward flexion and is young, then arthroscopic procedures with biceps tenotomy or tenodesis and partial repair could be considered, the goal being to transform an eventual E-type to a D-type and a D-type in an isolated supraspinatus IRCT. L'Episcopo or LDT should be discussed only in young patients with an intact subscapularis, no pseudoparalysis and with the presence of an external rotation lag sign above 40°.[13] Finally, older patients seeking a predictable outcome with respect to pain relief and range of movement and patients with pseudoparalysis should be considered for RSA. On the basis of the aforementioned elements, we use a treatment paradigm for all patients with IRCT (Fig. 3).

Conclusions

Various surgeries are proposed for similar posterosuperior IRCTs and preoperative patients' clinical evaluation. There is no panacea for primary treatment and patients must be aware, in case of a palliative or non-prosthetic option, of an alarming rate of structural failure (around 50%) in the short term. The current review does not support the initial use of complex and expensive techniques in management of posterosuperior IRCT. Further prospective and comparative studies with large cohort populations and long-term follow-up are necessary to establish effectiveness of expensive or complicated procedures such as SCR, biological augmentation or a subacromial spacer as reliable and useful alternative treatments for IRCT.

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