



Original Research

Latin American formal consensus on the indications for the surgical treatment of massive and irreparable rotator cuff tears

Diego A. Sánchez Cruz^{a,*}, Manuel Mosquera^b, Luciano A. Rossi^c, Paul Patiño^d, Roberto Yukio Ikemoto^e, Jorge Rengifo Miguel^f, Fernando S. Valero-González^g, Pablo Vargas C^h, Christian M. Lozanoⁱ, Paulo J. Llinás H^j, COLLABORATORS

^a Centro de Ortopedia y Traumatología, Bogotá, 110121, Colombia

^b Clínica la Carolina, Bogotá, 110121, Colombia

^c Hospital Italiano de Buenos Aires, Buenos Aires, C1199ABB, Argentina

^d Clínica Foianini, Artrocentro, Santa Cruz de la Sierra, 6R54 + 23, Bolivia

^e Faculdade de Medicina do ABC, Av. Lauro Gomes, 2000 - Santo André/SP, 09060-870, Sao Paulo, Brazil

^f Clínica Sanna el Golf, Lima, 15076, Perú

^g Hospital Ángeles Pedregal, Ciudad de México, 10700, Mexico

^h Hospital del Trabajador, Santiago, 7501241, Chile

ⁱ Clínica Anglo Americana, Lima, 15073, Perú

^j Hospital Universitario Fundación Valle de Lili, Cali, 760026, Colombia

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ABSTRACT

Objectives: To implement the Formal Consensus Method among a group of experts in shoulder surgery in Latin America, in order to establish appropriate indications for the surgical treatment of massive and irreparable rotator cuff injuries.

Methods: The Formal Consensus Method was used to develop surgical treatment recommendations for massive and irreparable rotator cuff tears (MIRCT). Three independent groups of experts in shoulder surgery were confirmed. The steering group conducted a systematic literature review and constructed a voting matrix consisting of 348 clinical scenarios. The rating group, composed of 15 members, rated each scenario on two occasions: first anonymously and then during an in-person discussion meeting. The median and voting ranges were used to classify each scenario as inappropriate, uncertain, or appropriate for each surgical technique. Finally, the reading group, consisting of 10 surgeons, reviewed, evaluated and rated the recommendations derived from the detailed analysis of the voting grids.

Results: The main finding of the study reveals a high percentage (70%) of clinical scenarios in which consensus was achieved regarding the appropriateness or inappropriateness of different surgical alternatives for the treatment of massive and irreparable rotator cuff injuries. Through a detailed analysis of the voting grids, a total of 20 recommendations were elaborated concerning the appropriateness of various surgical techniques in addressing irreparable rotator cuff tears.

Conclusions: The indications for the operative treatment of MIRCT were determined based on expert consensus and the best available evidence, they seek to provide guidance on the appropriateness of various surgical techniques for different clinical scenarios.

Level of evidence: V.

* Corresponding author. Tel.: +57 313 8726813

E-mail addresses: diegosancruz@hotmail.com (D.A. Sánchez Cruz), mosco61@gmail.com (M. Mosquera), Luciano.rossi@hospitalitaliano.org.ar (L.A. Rossi), rpaulpr@yahoo.com (P. Patiño), rob.ike@hotmail.com (R.Y. Ikemoto), jorgrenm@gmail.com (J.R. Miguel), shoulder.elbow@gmail.com (F.S. Valero-González), drpablovargas@gmail.com (P. Vargas C), lozanocm1@outlook.com (C.M. Lozano), paulollinas@gmail.com (P.J. Llinás H).

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What are the new findings?

- **Consensus Achieved:** The study revealed a high percentage (70%) of clinical scenarios in which consensus was achieved regarding the appropriateness or inappropriateness of different surgical alternatives for the treatment of massive and irreparable rotator cuff injuries. This consensus was reached among a group of experts in shoulder surgery in Latin America.
- **Surgical Recommendations:** Through a detailed analysis of the voting grids, a total of 20 recommendations were derived concerning the appropriateness of various surgical techniques in addressing massive and irreparable rotator cuff tears.
- **Valuable Resource for Clinicians:** The consensus recommendations provided in this study can serve as a valuable resource for clinicians when making surgical decisions for patients with massive and irreparable rotator cuff tears.

Introduction

Pain and functional impairment resulting from rotator cuff injuries directly affect the individuals' quality of life [1]. The functional compromise of the shoulder affects not only physical qualities but also the mental and social aspects of patients, in addition to being a predictor of depression, anxiety and sleep disturbances [2]. Successful surgical repair of these injuries – when non-surgical treatment has been unsuccessful – not only improves reported outcomes for patients but could also enhance the psychosocial status and health-related quality of life [2].

Approximately one-third of rotator cuff tears are considered massive and irreparable [3]. The definition of “massive and irreparable” implies a broad and controversial intellectual discussion. However, the Neer Circle Committee [4], based on the ASES MERIT study (American Shoulder and Elbow Surgeons Massive Cuff Evaluation and Research Initiative) [5], recently established the following definition: “a lesion involving two or more tendons, with retraction to the glenoid rim in any plane (axial or coronal), that is irreparable under any circumstances.”

A wide variety of surgical techniques are reported in the literature for managing an irreparable rotator cuff tear. The range of possibilities includes simple and less morbid strategies such as debridement and biceps tenotomy, partial repairs, subacromial balloon, and complex treatments such as augmentation patches, superior capsular reconstruction, tendon transfers and reverse shoulder arthroplasty, all with satisfactory clinical outcomes [6]. The multiplicity of surgical techniques and the absence of clinical studies with methodologies that adequately control for confounding factors and compare different techniques have an apparent effect on the clinician's daily practice when faced with this problem: uncertainty. Therefore, it is understood that irreparable rotator cuff tears pose an intellectual and technical challenge that requires a broad understanding and comprehension of the problem to be resolved.

The absence of high-level evidence studies and the uncertainty regarding the best surgical indication for a particular technique necessitates the best available evidence and the expertise of a group of experts through consensus. The formal consensus method described by the Haute Autorité de Santé (HAS) is a guide for developing consensus and clinical practice guidelines [7]. As a consensus method, its objective is to formalize the degree of agreement among experts through iterative assessments with feedback on points where the experts agree to provide recommendations for appropriate decision-making in specific clinical situations.

This study aimed to implement the formal consensus method to establish agreements on the appropriate indications for surgical treatment of massive and irreparable rotator cuff tears.

Methods

The present study was conducted using the formal consensus method of HAS [7]. This method involves three expert groups: the steering group, the rating group and the reading group.

The steering group is responsible for conducting a systematic literature review. Based on this review, a list of clinical scenarios is developed for which the intervention under consideration could be considered. The

rating group rates each scenario using an ordinal scale ranging from 1 to 9. A rating of 1 indicates “very inappropriate or contraindicated,” 5 represents “uncertain,” and 9 signifies “very appropriate or indicated.”

In the first round of rating, panelists individually rate each scenario. In the second round, a face-to-face meeting is organized and moderated by the chair of the steering group. During this meeting, the panelists discuss their individual ratings, with a focus on areas of disagreement. Following the meeting, a second round of voting is conducted, during which panelists may revise their ratings based on the discussions.

The results are then analysed, and judgements are consolidated using a predefined strategy that considers the median value and the range of votes. This process determines which scenarios reach a consensus, and these consensus results form the foundation for developing recommendations. The initial version of the consensus is reviewed by the reading group, which provides feedback on readability, acceptability and applicability. The final version of the consensus is prepared after a final meeting between the steering and rating groups, considering the feedback from the reading group.

Panel of experts

The panel of experts for this study was carefully selected to ensure diverse perspectives and expertise in the field. The selection process was carried out by the executive committee of the Latin American Society of Arthroscopy, Knee Surgery, and Sports Traumatology (SLARD), taking into consideration recommendations from regional scientific societies, reputation and peer consensus. The aim was to create heterogeneous groups with representatives from different geographical regions and diverse clinical practice settings, including university, public and private settings.

The panel was divided into three groups: the steering group, the rating group and the reading group. The number of participants in each group, as per the “Formal Consensus” methodology, should range from 8 to 15, aiming for diversity while ensuring active participation and efficiency.

The steering group consisted of 8 experts who were responsible for conducting a comprehensive literature review and synthesizing the evidence into an evidence summary. A search of PubMed/MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, LILACS, Scielo databases was performed using predefined study selection criteria, all eligible studies identified were extracted for relevant data, and results were narratively summarized (the search strategy is described in [Appendix 1](#), the evidence summary is reported in the *supplementary file*). Based on this, they developed a list of clinical scenarios to guide the selection of therapeutic strategies. These scenarios categorized patients based on important clinical and paraclinical variables that are relevant for making surgical decisions.

The rating group comprised 15 experts with relevant clinical expertise from various hospitals, academic institutions and private practice settings across Latin America. Their role was to rate the clinical scenarios developed by the steering group through two rounds of voting, following the rating rule mentioned earlier.

The reading group consisted of 10 experts specializing in shoulder surgery. Their responsibility was to evaluate the initial version of the consensus. They provided formal feedback on the feasibility, accessibility and readability of the recommendations and conclusions. Each recommendation was rated on a scale of 1 (complete disagreement) to 9 (complete agreement), considering the evidence summary provided and the expert's own experience.

Clinical scenarios for rating

The construction of clinical scenarios followed the methodological strategy of the Research and Development University of California at Los Angeles method (RAND/UCLA) [8]. The scenarios were created through an iterative process based on the systematic review and multiple discussions within the steering group.

The first step involved selecting important variables to consider when making a surgical decision in patients with massive and irreparable rotator cuff tears. After reviewing the articles included in the evidence summary, all members of the steering group were surveyed using an open-ended question. They were asked about the sociodemographic, clinical and paraclinical characteristics they considered important for patients with diagnosis of MIRCT.

This survey resulted in 25 independent variables, which were then used to design the second survey. Participants were asked to rate the influence of these variables on a 5-point Likert scale when making a surgical decision.

After the selection of variables (Table 1), the subsequent step involved defining, categorizing and organizing them into columns and rows. This

process facilitated the creation of 336 clinical scenarios. These scenarios were designed to be exhaustive, comprehensive, mutually exclusive, homogeneous and manageable. The steering group continuously assessed the matrix of clinical scenarios, eliminating any implausible scenario.

The 336 scenarios were organized into four chapters, based on the patient's main symptoms (Fig. 1) (Chapter 1: Patient with pain but functional shoulder, Chapter 2: Patient with imbalance in the vertical plane, Chapter 3: Patient with imbalance in the horizontal plane, Chapter 4: Patient with a mixed imbalance). Each chapter was subdivided according to the different variables utilized.

Rating the clinical scenarios

The 336 clinical scenarios, along with instructions, definitions and the systematic review, were sent electronically to the 15 panelists of the rating group for the first round of voting. Panel members were requested to vote on the clinical scenarios independently and anonymously, taking into consideration their clinical expertise and the available evidence. They were then asked to return their ratings to the steering group.

The medians and level of consensus for each scenario were calculated based on an analysis rule, which will be described later.

A second round of voting took place after two face-to-face meetings of the rating group. The first meeting occurred in March 2022 in Cartagena, Colombia, during the International Congress of SLARD. The second meeting was conducted virtually in April 2022. These meetings were moderated by the chair of the steering group. During the meetings, the group discussed the clinical scenarios, the evidence summary and the rationale behind the members' votes. The focus was on areas where

Table 1
Variables selected by the steering group.

Variable/Term	Categories	Definition
Age	<60 years ≥60 years	Age in years at the time of surgery.
Involved tendons	Supraspinatus + Infraspinatus	Corresponds to the compromised tendon units of the Rotator Cuff, documented by imaging or intraoperatively.
Subscapularis involvement	Supraspinatus + Infraspinatus + Teres Minor Reparable lower half of subscapularis Irreparable lower half of subscapularis.	Refers to the involvement of the subscapularis tendon. It is considered irreparable when a Patte III retraction or fatty infiltration (Goutallier 3–4) is documented, and it is not possible to bring the tendon to the medial border of the lesser tuberosity during intraoperative evaluation.
Fatty infiltration	Fatty infiltration grade 1–2 Fatty infiltration grade 3–4	Rotator Cuff tendon tears induce muscular degeneration, characterized by infiltration of muscles with areas of fat. In 1994, Daniel Goutallier et al. [9] categorized this degeneration into 5 stages (stage 0: completely normal muscle without fat streaks; stage 1: muscle with some fat streaks; stage 2: significant fat infiltration, but more muscle than fat; stage 3: equal fat infiltration and muscle; stage 4: more fat than muscle). In this case, it refers to the fat infiltration or degeneration of the supraspinatus and infraspinatus muscles documented by imaging.
Active Elevation	Active elevation >90° Active elevation <90°	Defined as an active movement of shoulder abduction in the scapular plane, measured in degrees.
Massive and irreparable rotator cuff tear [5].		Refers to a shoulder with at least 2 tendon tears, with at least one exhibiting Patte III retraction or fatty infiltration (Goutallier 3–4), and it is not possible to cover the footprint during intraoperative evaluation [5].
Rotator Cuff arthropathy [10]		Kazutoshi Hamada et al., in 1990 [10] proposed a radiographic classification of massive rotator cuff tears primarily based on the acromiohumeral interval (considering it as a highly sensitive indicator of full-thickness rotator cuff tear, with a normal lower limit between 6 and 7 mm). The classification consists of 5 grades: grade 1: AHI is greater than 6 mm; Grade 2: AHI is less than or equal to 5 mm; grade 3: AHI is less than or equal to 5 mm and there is acromion acetabularization (defined as the concave deformity of the inferior surface of the acromion); grade 4: Glenohumeral joint space narrowing is added to the characteristics of grade 3; grade 5: Compromise and collapse of the humeral head. The examiner slowly raises the patient's arm just above the horizontal plane (between 90° and 120°) and asks the patient to actively maintain this position. It is considered a positive result if the patient is unable to do so, and the arm drops despite efforts to keep it elevated.
Drop-arm test or landing test [11]	Present Absent	The Hornblower's sign is performed with the patient seated, the elbow flexed at 90°, and the shoulder elevated 20° in the scapular plane. The arm is passively brought to the maximum external rotation minus 5° to allow for elastic recoil. The patient is asked to maintain this position while the examiner releases the wrist. A positive test is defined as any internal rotation greater than (40°).
Hornblower's sign [12]	Present Absent	

Chapter 1. Patient with massive and irreparable rotator cuff tear without arthropathy (Hamada 1 or 2), without anterosuperior escape, whose main problem is pain, has an active elevation greater than 90° and negative drop-arm test, partial restriction for active external rotation, and negative Horn Blower’s test.
Chapter 2. Patient with massive and irreparable rotator cuff tear without arthropathy (Hamada 1 or 2), without anterosuperior escape, whose main problem is limited range of motion. In this case, the patient has active shoulder elevation less than 90° and positive drop-arm test (complete passive elevation), partial restriction for active external rotation, and negative Horn Blower’s test.
Chapter 3. Patient with massive and irreparable rotator cuff tear without arthropathy (Hamada 1 or 2), without anterosuperior escape, whose main problem is limited range of motion. In this case, the patient has active shoulder elevation greater than 90°, negative drop-arm test, and positive Horn Blower’s test.
Chapter 4. Patient with massive and irreparable rotator cuff tear without arthropathy (Hamada 1 or 2), without anterosuperior escape, whose main problem is limited range of motion. In this case, the patient has active shoulder elevation less than 90°, positive drop-arm test, and positive Horn Blower’s test.

Fig. 1. “Chapters” based on the main symptoms of the patients.

agreement had not yet been reached. Following the discussions and suggested changes by the rating panel, a second list of indications, consisting of 348 clinical scenarios, was sent out for voting. Panelists had the opportunity to modify their ratings based on the previous discussions.

Analysis of the data

In the formal consensus method, the process of consolidating the results and judgements of the raters is explicit. Each procedure is categorized as “appropriate,” “uncertain,” or “inappropriate” for each specific clinical scenario, based on the median value and a measure of dispersion of the panel’s ratings.

The appropriateness of a procedure is assessed on a discrete numerical scale ranging from 1 to 9. A rating of 1 indicates that the procedure is considered “completely inappropriate” (or contraindicated or unacceptable), while a rating of 9 signifies that the procedure is deemed “completely appropriate” (or indicated or acceptable). Intermediate positions are represented by values between 2 and 8, with a rating of 5 denoting “uncertain.”

For each clinical scenario, the median, lower and upper values of the inter-percentile range (IPR) are recorded. Additionally, the disagreement index (DI) was calculated using the equations presented in Table 2.

In the formal consensus method, a surgical procedure was classified as “appropriate” if the median of the votes was equal to or greater than 7. It was considered “inappropriate” if the median of the votes was equal to or less than 3.5. For medians falling between 4 and 6.5, or in cases where there was a lack of consensus among the members, the procedure was classified as “uncertain.”

The DI was used to measure the level of agreement among the participants regarding the use of a specific surgical strategy. A DI value above one (>1) indicated disagreement or a lack of consensus among the participants. Conversely, a DI value below one (<1) indicated agreement or consensus among the rating members.

For the reading group, it was considered that they agreed if the median rating was above 6, and if more than 90% of the votes fell within the range of 5–9 for each recommendation.

Results

Overall rating results

After the completion of the first round of voting, it was observed that 176 scenarios (52%) had a median value of 3 or lower, indicating that they were considered inappropriate. 109 scenarios (32.4%) had a median

value between 4 and 6, reflecting uncertainty or lack of consensus. 51 scenarios (15.17%) had a median value of 7 or higher, indicating that they were considered appropriate.

Following the panel’s discussions and meetings, a second round of voting took place. During this round, an agreement was reached on 70% of the scenarios. Among the agreed-upon scenarios, 13% were classified as appropriate, while 57% were rated as inappropriate.

After conducting a detailed analysis of the voting grids (Appendix Figs. 1–4), a total of 20 recommendations were formulated. These recommendations are the result of the consensus-building process based on the panelists’ votes and discussions.

Debridement and biceps tenotomy

Agreement on inappropriate indications

- (1) Patients with vertical, horizontal, or mixed imbalance despite age, compromised tendon units, subscapularis condition, or degree of fatty infiltration.

Partial repair

Agreement on appropriate indications

- (2) Patients with a functional shoulder with injuries involving the supraspinatus and infraspinatus, without the involvement of the subscapularis or with a repairable subscapularis, with low degrees of fatty infiltration regardless of age.

Agreement on inappropriate indications

- (3) Patients with vertical imbalance with irreparable subscapularis injuries or high degrees of fatty infiltration.

Table 2
Calculation of disagreement index.
Lower limit of IPR = 33rd percentile of the series of ratings
Upper limit of IPR = 66th percentile of the series of ratings
IPR = (upper limit IPR) – (lower limit IPR)
IPRCP (central point of IPR) = average of upper limit IPR and lower limit IPR
Asymmetry index = (5) – (IPRCP)
IPRAS = 2.35 + (1.5* asymmetry index)
Disagreement index (DI) = IPR/IPRAS
IPR: interpercentile range; IPRCP = interpercentile range central point; IPRAS = interpercentile range adjusted for symmetry.

- (4) Patients with horizontal imbalance in the presence of an irreparable subscapularis injury.
- (5) Patients with both horizontal and vertical imbalance regardless of age, compromised tendon units, or degree of fatty infiltration.

Augmentation patch

Agreement on inappropriate indications

- (6) Patients with a functional shoulder, vertical, horizontal, or mixed imbalance regardless of age, compromised tendon units, or degree of fatty infiltration.

Subacromial balloon

Agreement on inappropriate indications

- (7) Patients with a functional shoulder, vertical, horizontal, or mixed imbalance regardless of age, compromised tendon units, or degree of fatty infiltration.

Tendon transfer (TT)

Agreement on appropriate indications

- (8) Patients with vertical imbalance, under 60 years of age, with intact or repairable subscapularis and varying degrees of fatty infiltration.
- (9) Patients with horizontal imbalance, regardless of age, with varying degrees of fatty infiltration.
- (10) Patients with mixed imbalance, under 60 years of age, with varying degrees of fatty infiltration and intact or repairable subscapularis.

Agreement on inappropriate indications

- (11) Patients with a functional shoulder over 60 years of age, with high degrees of fatty infiltration.

Superior capsular reconstruction (SCR)

Agreement on appropriate indications

- (12) Patients with a functional shoulder, under 60 years of age, with high degrees of fatty infiltration without the involvement of the subscapularis, or with a repairable subscapularis.
- (13) Patients with vertical imbalance, under 60 years of age, with varying degrees of fatty infiltration, without the involvement of the subscapularis, or with a repairable subscapularis.
- (14) Patients with vertical imbalance, over 60 years of age, with low degrees of fatty infiltration and intact or repairable subscapularis.

Agreement on inappropriate indications

- (15) Patients with an irreparable subscapularis tear.
- (16) Patients with mixed imbalance regardless of age, compromised tendon units, or degree of fat infiltration.

Reverse prosthesis (RP)

Agreement on appropriate indications

- (17) Patients with vertical or horizontal imbalance, over 60 years of age, with a high degree of fatty infiltration and irreparable subscapularis.

- (18) Patients with mixed imbalance over 60 years of age.

Agreement on inappropriate indications

- (19) Patients with a functional shoulder, regardless of age, degree of fatty infiltration, or compromised tendon units.

Reverse prosthesis + tendon transfer

- (20) Patients with mixed imbalance, high degrees of fat infiltration and irreparable subscapularis.

Discussion

This study combines an expert group's expertise and clinical judgement with the best available evidence to generate a series of indications for using specific surgical techniques to manage massive irreparable rotator cuff tears. The main finding of the study is the high percentage of clinical scenarios in which consensus was achieved (70%) in considering different surgical alternatives as appropriate or inappropriate for the treatment of these injuries.

Debridement and biceps tenotomy are reasonable surgical alternatives with satisfactory clinical outcomes in patients with MIRCT and preserved muscle balance, whose main clinical problem is pain [13,14]. Despite this, the consensus panel did not agree on the appropriateness of this procedure. However, there was agreement in considering it inappropriate for patients with muscle imbalance in either of the two planes. Klinger et al. [15] documented that a decrease in preoperative range of motion is associated with unsatisfactory clinical outcomes – according to the Constant-Murley score – when debridement and tenotomy are performed. Similar findings were described by Ho et al. [16], who reported that in patients with preoperative elevation less than 90°, the post-operative American Shoulder and Elbow Surgeon Score (ASES) was worse than in those with an elevation >90° and found a higher conversion rate to reverse prosthesis in the group of patients with restricted range of motion.

The panel considered that partial repair is an appropriate alternative for the treatment of patients with pain and functional shoulder, with an intact or repairable subscapularis and low degrees of fatty infiltration, and that it should be contraindicated in the presence of a vertical or horizontal imbalance in conjunction with an irreparable subscapularis tear or high degrees of fatty infiltration. The consensus from the Neer Circle [4] on the treatment of massive and irreparable rotator cuff tears achieved a 90% agreement in considering this alternative acceptable in the management of patients with similar clinical characteristics. Different studies have demonstrated satisfactory functional outcomes following partial repair [17–19], improvement in the range of motion in the vertical plane between 40°–52° and 1–10° of external rotation [17–19], with failure rates ranging from 2% to 10% [17,19]. Franceschi et al. [20] documented a negative association between the degree of fatty infiltration and the University of California–Los Angeles score (UCLA) following partial repair. The consensus result suggests that vertical muscle imbalance, combined with an irreparable subscapularis tear or high degrees of fatty infiltration, is an attribute that precludes partial repair. Inui et al. [21] documented the reversal of pseudoparalysis (PP) in patients with irreparable tears following margin convergence in 93% (74/80) of their patients; while the remaining 7% had involvement of 3 tendons and severe fatty infiltration as a common characteristic.

The panel agreed that using augmentation patches is inappropriate in managing irreparable rotator cuff injuries; nevertheless, clinical evidence suggests favourable functional outcomes when the patch is indicated in injuries involving the supraspinatus and infraspinatus, especially with low degrees of fatty infiltration [22–24]. The panel judgement to consider this alternative as not indicated is mainly due to the unavailability of this device in many Latin American countries, resulting in a lack

of clinical experience in its use.

Promising results with Subacromial Balloon treatment were reported in early case series with clinical follow-up ranging from 2 to 5 years [25, 26]. However, in a recent randomized clinical trial, Metcalfe et al. [3] reported that arthroscopic debridement was superior to subacromial balloon in irreparable rotator cuff lesions, recommending against using this device in such patients. The panel agreed to consider the use of subacromial spacer inappropriate for treating irreparable rotator cuff lesions.

The panel agreed that a tendon transfer is appropriate in patients with vertical imbalance, under 60 years of age, with intact or reparable subscapularis and varying degrees of fatty infiltration. Tendon transfers are a therapeutic option that aims to rebalance coupling forces, and they have been associated with several advantages, including improvement of the shoulder fulcrum, optimization of deltoid function, depression of the humeral head, and restoration of elevation and external rotation. Numerous studies have demonstrated satisfactory functional outcomes with long-term follow-up [27,28]. However, different authors have documented several attributes that affect clinical outcomes, such as age, sex, previous surgeries [29], concurrent subscapularis injury, degree of fatty infiltration [30], presence of PP [31, 32] and reversibility of the acromiohumeral interval [31]. On the other hand, Kany et al. [30] documented that latissimus dorsi transfer can be effective in individuals over 75 years. Morsey et al. [33] and Okutan et al. [31] demonstrated that neither sex nor previous surgeries affect the outcomes. Kanatli et al. [34] and Gunnai et al. [35] reported a reversal of PP after latissimus dorsi transfer, while Elhassan et al. [36] reported that PP does not seem to affect the functional outcome following lower trapezius transfer.

The panel considered that it is appropriate to consider a tendon transfer in patients with horizontal imbalance. Boileau et al. [14] described a rare subgroup of patients with isolated loss of external rotation due to involvement of the supraspinatus, infraspinatus and teres minor, creating an imbalance between internal and external shoulder rotators. Following a modified L'Episcopo tendon transfer, 84% of the patients were satisfied at 52 months of follow-up, and all had a modest restoration of external rotation that allowed them to have better control of the hand in space. Other authors, such as Neyton et al. [37], have documented findings with similar clinical outcomes in this type of patients.

A recent systematic review documented that Superior Capsular Reconstruction (SCR) is a surgical alternative that improves patients' clinical outcomes, surpassing the Minimum Clinically Important Difference in Visual Analogue Scale (VSA) and ASES. Additionally, it increases the range of motion for forward elevation and abduction [38]. The panel agreed to consider SCR in young patients (<60 years) with functional shoulder or vertical imbalance and varying degrees of fatty infiltration, provided that the subscapularis tendon is intact or reparable.

Although there is evidence of clinical benefits in terms of functional outcomes and range of motion following SCR, there is controversy regarding whether SCR is an effective strategy for reversing PP. Burkhart et al. [39] documented a reversal of PP (defined as active forward elevation <45°, with a full passive range of motion and no changes after the Lidocaine test) in 90% of the patients in a small case series ($n = 10$). Ulrich et al. [40] demonstrated a statistically significant improvement in forward elevation (from 28° to 154°), with 83% of patients (5/6) experiencing a reversal of PP after undergoing SCR. Similarly, Takayama et al. [41] reported a reversal of PP in 75% of cases (severe PP defined as active elevation <90°, associated with an inability to maintain the limb elevated above 90° after passive elevation in the "Landing Test +").

Factors associated with better clinical outcomes following SCR include the condition of the subscapularis tendon [41], absence of acromioclavicular joint disease, absence of graft re-rupture and younger age [42]; this may explain the lack of a clear consensus on the indication of SCR in individuals over 60 years old, both in the presence of a functional shoulder and vertical imbalance.

The panel agreed to consider a reverse shoulder arthroplasty an appropriate intervention for older patients with vertical and horizontal imbalance, high degrees of fatty infiltration, and irreparable subscapularis. However, it is contraindicated in the presence of a functional shoulder. Several authors have described the clinical outcomes of shoulder arthroplasty in the context of Massive, Irreparable Rotator Cuff Tears. These studies have reported statistically significant improvements in the Constant score, ranging from 14.5 to 42.5 points on average [43–45]. Additionally, the ASES score showed an average improvement of 42.1 points, along with improvements in the Simple Shoulder Test (SST) and the 12-item Short Form Survey (SF-12) [43]. When comparing patients with PP to those without PP, Boileau et al. [45] found a significant postoperative improvement in the Constant score for both groups. However, the average increase was greater in the PP group (37 vs 14.5, $p = 0.002$). They also observed a more significant gain in active range of motion for forward elevation in the PP group (64° vs –24°, $p < 0.001$). Patients with painful but non-pseudoparalytic shoulders experienced loss of shoulder elevation. Similar improvements in clinical outcomes, as measured by the Constant score, were reported by Favard et al. [44], they found greater average increases in patients with preoperative PP than in those without PP (42.5 vs. 17, respectively).

In a level IV study conducted by Berglund et al. [46], the target population consisted of patients with loss of both elevation and external rotation (mixed imbalance) due to Massive Irreparable Rotator Cuff Tears. The study demonstrated an average improvement in active external rotation from –21° to 28° following RSA with a lateralized centre of rotation. In a randomized clinical trial by Young et al. [47], the objective was to evaluate RSA with and without Latissimus Dorsi and Teres Major Transfer in patients with loss of elevation and external rotation. The trial results did not reveal statistically significant differences in Activities of daily living requiring active external rotation (ADLER), Disabilities of arm shoulder and hand (DASH), ASES and Simple Shoulder Test (SST) after two years of follow-up. However, it is noteworthy that the intervention group (RSA) exhibited a resolution of the Hornblower sign in 73.3% of the patients.

One of the strengths of the present study is the use of a formal consensus methodology established and validated by other authors to determine the appropriateness of different treatments. Involving a wide range of scenarios and considering different clinical and paraclinical variables based on the patient's clinical symptoms allows for a pragmatic and generalizable approach. The strict independence of the steering group, responsible for formulating the proposals, and the rating group, responsible for evaluating them, as well as the review by the reading group, prevents a single group from being both judge and jury.

The main limitation of this study is the absence of level I studies on which to base the voting judgements. While the categorization by chapters and the subdivision by different variables aim to involve a wide range of patients, this may oversimplify the decision-making process by not considering other potentially important variables.

Conclusions

Our study has identified consensus agreements regarding the appropriateness of various surgical procedures in managing MIRC based on different clinical scenarios. For partial repair, it is considered appropriate in cases where patients have a functional shoulder without subscapularis involvement, or if the subscapularis can be repaired, and low degrees of fatty infiltration, regardless of the patient's age. Tendon transfer is deemed suitable for young patients with vertical imbalance and an intact or repairable subscapularis, as well as various degrees of fat infiltration. It is also considered appropriate for patients of any age with horizontal imbalance and for those under 60 with mixed imbalance. Superior capsular reconstruction is considered a viable option for young patients with a functional shoulder, high degrees of fatty infiltration and no subscapularis involvement, or with a repairable subscapularis. It is also suitable for patients with vertical imbalance, and an intact or repairable

subscapularis.

The consensus recommendations provided in this study can serve as a valuable resource for clinicians when making surgical decisions for patients with massive and irreparable Rotator Cuff Tears. These recommendations are based on expert consensus and the available evidence, and they provide guidance on the appropriateness of various surgical techniques for different clinical scenarios.

It is important to note that these recommendations are subject to individual patient factors, and clinical judgement should always be exercised when applying them. The findings of this study highlight the need for further research and high-quality clinical studies to strengthen the evidence base and resolve uncertainties surrounding the surgical management of massive and irreparable Rotator Cuff Tears.

Declarations

All the authors had approved the final form.

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Ethical approval

N/A.

Informed consent

N/A.

Author contribution

DS project leader. MM: Original idea. PL: Coordinator of the steering group and review and edited the manuscript. CL: Coordinator of the steering group. LR, PV, PP, FV, RI, JR: Developed the literature review, developed the clinical scenarios to be voted and review and edit the manuscript.

Availability of data

The datasets used or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: DS reports administrative support and article publishing charges were provided by Latin-American Society of Arthroscopy, Articular replacement, and Sports Injuries.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jisako.2024.01.001>.

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