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Review Article

Irreparable subscapularis: Guide for surgeons

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ABSTRACT

The subscapularis (SSC) muscle, one of the four rotator cuff (RC) muscles, plays a crucial role in balancing and moving the shoulder. Cases of irreparable SSC tears are difficult entities within shoulder surgery. Different techniques have been suggested with different outcomes but with no golden standard these days. Musculotendinous transfers, anterior capsular reconstruction (ACR), shoulder arthroplasty and even arthrodesis are the current options available. This article provides a review of existing literature on this entity, covering clinical work-up, operative possibilities, techniques, and rehabilitation.

1. Introduction

The subscapularis (SSC) is part of the four rotator cuff (RC) muscles and the most powerful of all four. Predominantly functioning as an internal rotator, but also as a dynamic stabiliser and transverse coupler with the posterior cuff (teres major and infraspinatus), being indispensable for proper shoulder function.[1]

The first documentation of SSC tears, once known as the forgotten tendon, dates back to 1834 by Smith. The first publication for open SSC repair was in 1954 by Hauser[2], followed by arthroscopic repair pioneered by Burkhart.[3]

The diagnosis of a SSC tear is frequently missed, leading to delayed surgery, with an average of 18 months. This delay in surgery is correlated with a higher grade of atrophy and fatty infiltration, decreasing the biological healing capacity.

Full thickness tears, only seen in 5% of the SSC tears[4], alter the biomechanical balance between internal and external rotators resulting in decreased shoulder function, pain, pseudoparalysis, anterior instability and even cuff related arthropathy. Most SSC tears occur concomitantly with superior cuff tears, referred to as an anterosuperior cuff tear described by Warner[4], translating the shoulder anterosuperiorly.

Managing irreparable SSC tears proves to be more challenging than acute tears. Literature outlines both anatomical interventions, such as anterior capsular reconstruction (ACR), and non-anatomical approaches, such as musculotendinous transfers, for irreparable SSC tears. With this review, we provide a full overview of pre-operative work-up, detailed operative techniques and outcomes.

2. Materials and Methods

We conducted a search on PubMed using the keywords "subscapularis" and "irreparable", both for “title and abstract”, which gave a total of 220 hits. Additionally, we specifically looked for "irreparable subscapularis" in the” title and abstract”, resulting in 59 matches. We initially reviewed the article titles, and if relevant to our research, proceeded to evaluate the abstracts to determine whether to include the article and proceed with reading the full text. A total of 46 articles were included.

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2.1. Anatomy

2.1.1. Subscapularis (SSC)

The SSC muscle originates from the subscapular fossa and insert on the lesser tuberosity (medial to the bicipital groove), with a relative cross-sectional mass of 53% of the total RC.[5]

Clinically, the upper part of the SSC is characterized by a thick tendon, responsible for internal rotation. It makes up 2/3 of the muscle and is innervated by the superior subscapular nerve. The lower part, the more muscular part, plays a crucial role in stabilization, especially in abduction and external rotation. This part is innervated by the lower subscapular nerve.[6]

Given that SSC and LHBT share a close anatomical relationship, concomitant biceps issues are observed in 20-90% of cases.[7] Shi et al.,[7] revealed that when there are no biceps issues, there is a negative predictive value of over 90%. However, the positive predictive value is only 35%.

3. Clinical Workup

3.1. Physical examination

In routine practice, it is useful to consistently perform three specific SSC tests. These include the belly press test, the lift off test /internal rotation lag sign and the bear hug test. Together these tests exhibit a sensitivity of 80%.[8]

Besides SSC evaluation, it is crucial to test anterior instability using tests such as the apprehension test, relocation test, load and shift test and sulcus sign. As anterior instability influences the operative decision-making process.

3.2. Imaging

3.2.1. CT and MRI

As MRI has largely replaced CT, the latter remains a good alternative if MRI is contraindicated or in preoperative planning for arthroplasty.

MRI exhibits varying sensitivity (36%-82%, increasing with tear size) and specificity (approximately 95%-100%) in different studies.[9] Various signs have been described to identify SSC tears in MRI. Lee et al.,[10] found that fluid in the superior subscapular recess to be the most sensitive sign, especially in partial SSC tears and Reichel et al.,[11] suggested a CHI cutoff less than 9.5 mm on MRI is highly specific for SSC tears.[10]

Comma sign has traditionally been used for arthroscopic identification of SSC tears. Recent studies indicate that MRI can also effectively identify the comma sign, particularly in Lafosse type 3, 4, and 5.[12]

3.2.2. Irreparability of the SSC

Irreparable SSC is determined by MRI findings, including fatty infiltration, retraction, muscle atrophy and humeral head migration.[13] These factors determine the healing potential of the RC.[14]

Fatty infiltration is classified by the Goutallier grading, with grade 3 defined as irreparable.[15]

Retraction is classified by the grading of Patte, stage 3 is defined as irreparable.[16,17]

Muscle atrophy is defined when the muscle belly does not cross the line between the edge of the coracoid and inferior scapular tip.[14]

If the humeral head is migrated anteriorly and fixed with no reducibility, it is defined as irreparable.

3.2.3. Treatment

Given the difficulty of this condition and sometimes unpredictable and less favorable results of surgical interventions, conservative therapy is recommended for a minimum of 3-6 months. This includes non-steroidal anti-inflammatory drugs (NSAIDs), pain medication, corticosteroid injections and physical therapy.

Operative procedures are primarily salvage measures and rarely lead to exceptionally good results. The aim is to gain time and slow down the degenerative process in young patients until arthroplasty is justified.

3.3. Musculotendinous transfers = the non – anatomical method

Patients for whom a transfer is a viable option typically include young (<65 years), active individuals without arthritis, where pain is a significant factor and with no evidence of instability.

There are several relative contraindications for transfers due to the unpredictability of outcomes. These include associated irreparable posterosuperior tears (due to persistent imbalance), anterior subluxation, osteoarthritis, pseudoparalysis, stiffness/arthritis.[18]

At the end of each surgical section, a link to a video demonstrating the relevant surgical technique is provided.

3.4. Pectoralis major transfer (PmaT)

The PmaT was first described in 1997 by Wirth and Rockwood and has been the most commonly used transfer for many year.[19] However, recent biomechanical investigations have indicated that the line of pull associated with this transfer does not adhere to the fundamental principles of tendon transfers, as the line of pull being perpendicular to that of the SSC in the axial plane.[20] This discrepancy may be attributed to the relatively anterior attachment of the Pma, resulting in a more anterior vector.

Several modifications have been attempted to align the vectors more closely to those of the SSC. These modifications include transferring under the conjoint instead of above[21,22] or transferring only the sternal head.[23] However, these adjustments have not yielded significant

Table 1

- First confirm the irreparability by fully releasing the SSC
- Biceps tenodesis or tenolysis is advocated, given the strong association with SSC pathology
- Repair present posterosuperior tears, if feasible
- Careful dissection, identification and protection of the nearby nerves should always be performed to prevent nerve damage
- The transfer
    - To ensure sufficient excursion, adequate release should be performed
    - Protect the transfer neurovascular bundle
    - Humeral fixation point is located at the most superior part of the SSC footprint, and at the anterosuperior part of the greater tuberosity if an (ir)reparable posterosuperior tear is present
    - Preparing fixation site by removing soft tissue until reaching bleeding bone, avoid excessive decortication as it may compromise the anchor grip.
    - Lateral row should be used, as it provides a larger contact surface between the tuberosity and transferred tendon, creating a larger healing surface

Figure 1: General surgical aspects that apply to all transfers

improvements, as both vectors (Pma and SSC) remain notably different.[23] As previously mentioned, anterior subluxation is a relative contraindication, especially with the anterior vector associated with the PmaT, as it may exacerbate instability.[22]

3.5. Open operative procedure in beach chair[18,24,25]

The patient is positioned in beach chair, and a deltopectoral approach is performed. The Pma insertion, lateral of the bicipital groove and anterior to the biceps, is identified. Various harvesting options have been described: the entire tendon, only the superior 2/3 according to Resch's technique, only the sternal head or clavicular head. Currently, harvesting and transferring the sternal head alone is recommended. Medially, the sternal head initially lies inferiorly to the clavicular head, but as it approaches the humeral insertion, both heads rotate 180° around their axis, positioning the sternal head posterior and superior to the clavicular head. When transferring the entire tendon, be aware not to rotate the tendon on its axis.[24]

The sternal head dissection starts medially to the insertion, facilitating the differentiation between both heads. The clavicular head is pulled proximal, providing a clear view upon the belly of the sternal head behind. Blunt dissection is performed, following the anterior surface of the sternal head up to the insertion. Detaching options are either with (subperiostally) or without (peel-off technique) bone flake, performed in a superior to inferior direction. Incorporating a small bone flake provides with a favorable bone-to-bone healing. Traction sutures are placed through the tendon and is mobilized. The superior, inferior and posterior edges are released from lateral to medial to obtain further excursion. The maximum medial release is 7-8 cm, as you will encounter the Pma innervation (medial and lateral pectoral nerves). The subcoracoid space is created by blunt finger dissection from lateral to medial beneath the coracoid and by dissecting medially to the coracoid, between the conjoint tendon and the pectoralis minor, with caution to avoid damage to the brachial plexus and the vascular structures here. The musculocutaneous nerve is identified, entering the conjoint tendon at approximately 6.1cm below the coracoid. The tendon with traction sutures is transferred under the conjoint and anterior to the musculocutaneous nerve. Final fixation is performed with the arm in 30° abduction, 30° elevation and 30° exorotation.[24,26]

3.6. Outcomes post PmaT

Musculocutaneous nerve impingement most frequently occurs after entire tendon transfer. Ruiz-Iban et al.,[27] found, after sternal head transfer, critical contact in 21% of the cases. Klepps et al.,[26] confirmed nerve impingement in 6 out of 20 shoulders after entire tendon transfer. Besides nerve impingement, transferring the entire tendon is no longer recommended as it aesthetically contributes to raising the axillary fold.

Post-arthroplasty, the clinical outcomes exhibit inconsistency. Updegrove et al.,[24] reported good clinical outcomes concerning pain and range of motion (ROM). However, despite initial correction of anterior subluxation, recurrences were observed but with no correlation to pain or function. Elhassan et al.,[23] observed, after 53 months of follow-up, persistent postoperative subluxation in cases where it was present preoperatively. They also noted a retear rate exceeding 50%, minimal improvement in the CS score and pain relief observed in only 1 out of 8 cases.

Most of the literature agrees that transferring the sternal head alone yields superior clinical outcomes, particularly when there is no pre-existing anterior subluxation.[20,23,28] This was confirmed in biomechanical cadaver studies (22, 29).[22,29] However, in a comparative study by Valenti et al.,[18], no significant difference was observed between sternal and clavicular head transfer, as both groups showed significant improvement in CS score.

Biomechanical studies favor transfer under the conjoint tendon. A study by Konrad et al.,[22] showed that transferring underneath the conjoint, particularly with the sternal head, is more effective in restoring kinematics compared to transferring above. Similar findings were reported by Jennings et al.,[29]. However, despite these promising outcomes observed in cadaveric studies, their translation into improved clinical outcomes remains uncertain.[21,23,30] Currently, there are no clinical comparative studies directly comparing transfer above versus below the conjoint tendon.

In the presence of a concomitant posterosuperior tear, literature shows worse outcomes when these tears are not repaired or irreparable. However, when these tears are repaired, the results are nearly equivalent to intact posterosuperior cuff.[28] Pronounced atrophy or fatty infiltration of an intact posterosuperior cuff also results in poorer outcomes.

Moroder et al.,[20] demonstrated that after a long follow-up of 9-11 years, the objective outcomes, which initially improved post-operatively, regressed to pre-operative levels over time. However, the relief in pain persisted.

A review conducted by Shin et al.,[28] included 8 studies with a total of 195 shoulders. All studies showed a clear improvement in CS score (mean 61) and pain. Concerning complications, only one transient musculocutaneous nerve palsy and one axillary nerve palsy was observed.

3.7. *Pectoralis minor transfer (PmiT)*

The PmiT, like the PmaT, was initially described by Wirth and Rockwood in 1997.[19]

In contrast to the Pma, the excursion length is shorter, resulting in fiber stretching and reducing the force it can generate.[25] Additionally, Pmi muscle diameter is much smaller compared to the Pma, further contributing to diminished strength.

3.8. *Open operative procedure in beach chair*[31,32]

The incision is made like a latarjet procedure, measuring between 3 to 5 cm, with subsequent deltopectoral dissection. The coracoid is freed from the tip to the insertion of the Pmi and from the tip to the coracoacromial ligament, which is preserved. The Pmi is harvested through an osteotomy, starting 3-4 mm laterally from the medial edge. A larger osteotomy increases the risk of coracoid fracture. Alternatively, it can be harvested using the peel-off technique.

Traction sutures are placed around the tendon and around the bone block if present.

The Pmi is further released on the posterior side (be aware of the brachial plexus) and on the medial side, between the lateral thoracic nerve branches. Additional excursion can be achieved by releasing a few fibers of the tendon. Proper release is crucial to prevent overtensioning of the fibers, resulting in poor outcomes.

The tendon is transferred under the conjoint after creating the subcoracoid space, in the same manner as for the PmaT, and securely fixed to the lesser tuberosity.

To ensure adequate space for the transfer, a coracoidplasty of 3-4mm can be conducted.

3.9. *Outcome*

After 2 years of follow-up, Paladini et al.,[25] reported an improvement in CS score (with 41 points), VAS score (5,6 points) and ROM, but no improvement in strength. Performing an osteotomy makes the coracoid vulnerable to fractures. Especially, if the osteotomy exceeds 3-4mm. Paladini et al.,[25] reported only 1 coracoid fracture out of 27 shoulders was reported.

The failure of restoring internal rotation force, is supported by the biomechanical cadaver study by Kontaxis et al.[16]

Tsukuda et al.,[31] conducted a study investigating the efficacy of combining PmiT with superior capsular reconstruction (SCR). Previous literature has indicated suboptimal outcomes when SCR is performed alongside irreparable anterosuperior cuff repairs.[33] However, this study demonstrated favorable clinical outcomes following PmiT for irreparable subscapularis in combination with SCR, suggesting that PmiT could serve as a viable surgical option.

4. Latissimus dorsi transfer (LDT)

The LDT was first used for Erb's palsy and posterosuperior cuff problems.[34] In 2014, Elhassan et al.,[35] introduced the transfer for anterosuperior cuff tears after a biomechanical study. Unlike PmaT and PmiT, this transfer showed a parallel line of pull relative to the subscapularis in a horizontal plane and a 45° angle in a coronal plane. Another advantage of the LDT is the synergistic action of both the SSC and latissimus dorsi (LD), serving as internal rotators.

The primary nerves of concern during the transfer are the radial nerve, along with the posterior cord of the brachial plexus and the axillary nerve. However, studies have indicated that the risk of nerve damage is minimal if the nerves are carefully identified and protected.

4.1. *Open operative procedure in beach chair*[36–39]

The patient is positioned in beach chair, and a deltopectoral approach is performed. The inferior edge of Pma is identified, followed by blunt dissection underneath Pma until reaching the humerus, similar to the technique used in a subpectoral biceps tenodesis procedure. A homann retractor is then positioned behind the humerus and under the Pma, facilitating proximal retraction of this tendon. Alternatively, a proximal tenolysis of the Pma can be performed instead of proximal retraction.

Locate the plane between the long and the short head of the biceps and dissect between the two, revealing the attachment of the LD. The radial nerve can be identified on the medial side, 5 cm from the musculotendinous junction, coursing over the LD. The axillary nerve can be identified on the superior edge of the LD. Besides these 2 nerves, be aware of the motor branch of the long biceps (which crosses anterior to the LD) and the brachial plexus. Separating the TM from the LD is achieved by finding the dissection plane at the superior edge of the LD.[35]

The LD is detached from the humerus, with or without a bone flake, while the arm is in adduction and external rotation (or in abduction, elevation, and internal rotation in the case of an axillary incision). The LD is released on the inferior (triceps), anterior and posterior side (TM). Once sufficient excursion is achieved, the tendon is tubularized and passed beneath the pectoralis major toward the fixation point.

Remark: If more excursion is required, a posterior axillary incision is recommended. This incision follows the posterior axillary line, starting 2 cm on the upper arm and extending 3 cm on the chest wall. After dissecting through the subcutaneous fat, the LD is the first muscle encountered. The LD is followed cranially to its insertion site on the humerus and the dissection plane with the TM on the posterior side is identified.

This approach allows for a better release of the tendon from the scapula, the skin, the TM, the triceps and the pedicle.

The pedicle courses approximately 8-10 cm distal to the humeral insertion at the anterior border, originating from the axillary fold and entering the anterior surface of the LD.

4.2. Outcomes

The reason that LD should not be harvested and transferred together with TM is based on a study by Elhassan et al.,[35]. They reported a clear impingement between the two transferred tendons and the axillary nerve and radial nerve, regardless of the fixation point on the lesser tuberosity.

Mun et al.,[37] showed significant improvement in 24 shoulders for ASES, CS and VAS score with no cases of reruptures or nerve damage in a total of 24 shoulders.

Elhassan et al.,[36] reported good clinical outcomes in 56 shoulders, with no cases of nerve damage. Only 9% of cases experienced retears, and among the 27 patients with preoperative subluxation, postoperative correction was achieved in 24 cases. Additionally, 51 out of 56 transfers exhibited marked contraction of the LD.

Werthel et al.,[38] reported 79% shoulder stability after LDT, with significant improvements in VAS, CS, and ASES scores, and overall good to very good outcomes, particularly in patients with persistent anterior subluxation post-latarjet procedure. Suggesting that LDT provides effective shoulder stabilization and strength.

Kany et al.,[39] performed a full arthroscopic technique on 5 shoulders with a 12-month follow-up. They observed significant improvement in CS scores (from 32.5 to 68) and subjective values. Total of 1 rupture (due to infection) and no case of nerve damage were reported.

5. Comparative studies between transfers

In a review by Luo et al.,[40] a comparison was made between PmaT (184 shoulders) and LDT (85 shoulders) for irreparable SSC. They concluded superior outcomes in all aspects for LDT, including: patient score, failure rate (7.06% compared to 12.9%) and internal rotation strength (1030N compared to 462N). Anterior subluxation was significantly higher post PmaT.

A computer-based biomechanical study by Kontaxis et al.,[16] compared three transfers (LD, Pma, and Pmi). Their findings revealed that Pma and Pmi generate an anterior translation force after certain internal rotational degree, as the line of pull becomes parallel with the force vector. Explaining the poor/unpredictable outcomes in patients with known anterior subluxation. In contrast, LD can generate nearly the same force as the SSC irrespective of the degree of internal rotation. Concluded that LD is the preferred transfer.

A biomechanical study by Werthel et al.,[41] compared transfers (Pma, LD, and TM) in shoulders with or without RSA. In the native shoulder teres major transfer (TMT) and LDT are superior to PmaT. When a RSA is implemented, the PmaT is superior. This explained by the constraint of the RSA, turning anterior translation into rotational translation.

6. Other possible transfers

6.1. Lower trapezius

This transfer was originally described by Elhassan in 2009 to restore external rotation in patients with brachial plexus injury.[42]

Studies on lower trapezius transfers (LTT) are mainly focused on posterosuperior cuff tears, with good clinical outcome.[43–46] Notably, LTT offers advantages over LDT concerning harvesting and muscle retraining during rehabilitation.[47]

Cartaya et al.,[48] demonstrated that the LTT has the same vector as the SSC in both the axial and the coronal planes.

Due to the limited excursion of the LT, each transfer needs an augmentation with a semitendinosus autograft or achilles tendon allograft.

Only one study was found on upper trapezius transfer (UTT) in anterosuperior tears, conducted by Goutallier et al.,[17] The reported clinical outcomes were inferior compared to no transfer.

6.2. Teres major

Lafosse et al.,[49] demonstrated the feasibility the TM transfer, involving a bipolar transfer. Fixing the teres major at the exact location of the SSC.

7. Anterior capsular reconstruction (ACR) (the anatomical method)

ACR had its introduction in shoulder surgery following promising results of superior capsular reconstruction (SCR).[50–52]

Its primary objective is to establish postoperative shoulder stability by creating a stable fulcrum, leading to improved shoulder function.[33] In cases where enhanced internal rotation strength is desired, a combination of ACR with tendon transfer may be necessary. However, it's important to note that postoperative stiffness is a common issue following ACR.[53–55]

7.1. Open operative procedure[53,54,56–59]

The patient is positioned in beach chair and a deltopectoral approach is performed. To enhance visibility, the proximal 1/3 of the Pma is released. The remnants of SSC and capsule can be removed or preserved and incorporated into the graft at the end. Incorporating the remaining SSC can induce some internal rotation during muscle contraction.[55] A fukuda retractor is placed into the glenohumeral joint, achieving posterior movement of the humeral head and optimizing the view on the glenoid. Various anchor positions are debated in the literature regarding their relation to the labrum. One approach involves leaving the labrum in place and positioning the anchors either anteriorly on the glenoid[53] or more medially on the glenoid neck.[51,60] Alternatively, the labrum can be detached using a Bankart knife and the anchors can be placed on the glenoid rim, such as in a Bankart repair. In this scenario, the labrum can then be reattached along with the graft.[59,61] Removing the labrum[51,59] might be overly aggressive, given the importance of any form of stability in such complex cases. A bleeding surface is created before placing the anchors. The number of anchors placed is estimated between two and four. Two anchors, are ideally placed at 1 and 5 o'clock,[62] while three anchors are placed at 1-3-5 o'clock. We recommend a total of three anchors. In cases where tendon graft is utilized, four anchors are placed at 2-3-4-5 o'clock. At the level of the lesser tuberosity, a double row speed bridge technique is used, involving two medial and two lateral anchors. The medial anchors are placed at the level of the SSC footprint, which has a triangular form. This means that the superior anchor is placed more medial, at the transition zone between the bicipital groove and the cartilage and at the same height as the 3 o'clock glenoid anchor. In contrast, the inferior anchor should be positioned 1-2mm more lateral from the cartilage. The second row of anchors are placed 15mm lateral to the first row,[59] typically at the level of the bicipital groove. A bleeding surface is created before anchor placement.

Suturing of the graft starts at the glenoid side, with the two limbs of the middle anchor passed through the graft 3mm from the edge,[61] along with one limb from both the superior and inferior anchors. The graft is pulled inward against the glenoid by first tying the middle anchor, followed by tying the inferior and superior anchors after passing the remaining limbs.

For final fixation on the humerus site, the arm is positioned in 30° abduction, 30° external rotation, and 30° elevation. This position ensures a good balance between stability and tensioning, without excessive stiffness.[57]

Do not close the entire rotator interval, as it may cause excessive stiffness.[52]

7.2. Graft choice

The two most effective and commonly used grafts are Human Dermal Allograft (HDA) and tensor fascia lata, both with superior outcomes compared to tendon grafts.[24,63]

Advantages of HDA over tensor fascia lata autograft include avoiding donor site morbidity: pain, deformities, numbness, claudication and possibly muscle prolapse.[33,64] HDA serves as a scaffold for rotator cuff ingrowth.[50,54] The use of HDA is recommended in individuals with increased laxity or collagen disorders, as their own tissue (autograft) would also exhibit these laxity characteristics, resulting in less favorable outcomes.[59]

7.3. Graft size

The required size is measured intraoperatively with the arm in 30° external rotation and 30° abduction. An additional 5-10mm is added to each edge[53,54,58,62] and if a lateral row is placed, an extra 10-15mm is added to the lateral edge.[55,60] An advantage of an open procedure compared to arthroscopic surgery, is the ability to choose a slightly larger graft in an open surgery, as it can be trimmed if necessary.[61]

7.4. Graft thickness

The literature concerning anterosuperior rotator cuff tears, reports HDA thicknesses ranging between 2mm and 4mm.[56–60] In the case of an autograft such as tensor fascia lata, the thickness should approximate that of a native cuff (8mm) with a similar degree of firmness. Thickness is obtained by folding the graft and firmness by incorporating a MESH or using mattress stitches with 5-10 non-absorbable sutures.[65]

7.5. Outcomes

Most case reports concerning tensor fascia lata show good clinical outcome.[62,66] Other case reports describe the surgical technique but no post-operative outcomes.

More extensive literature is available on HDA compared to tensor fascia lata. A case series involving 7 shoulders by Lee et al (56) reported a 90% satisfaction rate with no complications. Pain improved in all the patients, with 60% experiencing no pain at all.

Two cadaver studies performed by Komperda et al.,[54] (involving 6 shoulders) and Omid et al.,[53] (involving 8 shoulders), showed that ACR was necessary to resolve anterior subluxation, with no significant difference observed between ACR performed with or without tendon transfer (PmaT or LDT). The remaining literature consists of case reports with good clinical outcomes.[57,58,67]

Millett et al .,[68], Dewing et al.,[51] and Alcid et al.,[63] have all reported a 30% persistence of anterior instability when using semitendinosus or tibialis anterior grafts. Only De Carli et al.,[69] and Warner et al.,[70] have suggested somewhat favorable post-operative results.

8. Conclusion

As evidenced by the literature, every patient should be started on conservative therapy for 3-6 months. If this does not provide sufficient improvement, there is an option for surgical intervention.

LDT is currently preferred over PmaT. Apart from these 2 major transfers, there are smaller studies concerning other transfers as Pmi, LTT and TM. Anatomical reconstruction, successful in posterosuperior cuff tears, has promising outcomes as an ACR.

In older, low demand patients (>65 years) with stiffness/arthritis, or pseudoparalysis, RSA is a valuable option.

9. Conflict of Interest

None.

10. Source of Funding

None.

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