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Management of rotator cuff tears in the elderly population

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ABSTRACT

Rotator cuff tears (RCTs) are a common cause of shoulder pain and weakness in the elderly (age > 65yrs) and result in reduced quality of life, loss of income and a burden on health care. With the elderly population living longer there is a growing interest in the effective and efficient management of RCTs. In a majority of cases, the initial treatment is conservative, with physical therapy, analgesics and possibly corticosteroid or plasma rich protein injections. There are various surgical options, including rotator cuff repair, superior capsule reconstruction, subacromial decompression and reverse shoulder arthroplasty. The aim of this article is to provide a narrative review of evidence guiding the management options for RCTs in the elderly.

1. Introduction

A rotator cuff tear (RCT) is a relatively common cause of shoulder pain and weakness which can progress to pseudo-paralysis and osteoarthritis [1]. Overall the condition reduces quality of life years, directly increasing the burden on health care through cost of diagnosis and management, as well as indirectly through loss of income, disability payments and missed days at work [2]. The prevalence of RCTs increases with age and can affect up to 70% of those aged over 70 years [3]. RCTs vary in size, many are asymptomatic and most are atraumatic in origin. With the elderly population (age > 65 years) living longer and being more physically active there is growing interest in the effective and efficient management of RCTs in this demographic [4].

The initial treatment for most RCTs is conservative; consisting of lifestyle modification, pharmaceutical therapy (corticosteroids or platelet rich plasma injections, oral analgesics) and or physiotherapy [5]. Surgery can be considered for symptomatic tears that have failed conservative management. Surgical management may include rotator cuff repair, acromioplasty, biceps tenodesis or tenotomy, or arthroplasty [5]. Surgical treatments are becoming increasingly common in the elderly population due to many patients remaining highly active, demanding a functional and painless shoulder [6]. The aim of this article is to provide a narrative review of recent evidence to gain a better understanding of the natural history, clinical evaluation and surgical management options of rotator cuff tears with particular reference to the elderly population.

2. Methods

A broad search of PubMed, Medline, Cochrane and Research Gate was undertaken with greater emphasis placed on more recent studies. We utilised the following key terms (and closely related MESH terms); “rotator cuff”, “rotator cuff repair”, “elderly”, “shoulder arthroplasty”. The searches were limited to full text articles, human studies and those published in the English language.

A total of 176 articles were identified after the preliminary search and title review. An abstract review was carried out prior to selection of articles for a full text review. Articles that were not available as full text were excluded from ongoing review. Overall, a total of 57 articles were utilised for this review article which included 32 review articles, 6 randomised control trials, 11 cohort studies, 4 case control studies, 3 meta-analysis and 1 registry report. Included study’s reference lists were also searched for additional relevant information.

3. Anatomy and biomechanics of the rotator cuff

The rotator cuff consists of a four-muscle tendon unit, with the muscles originating from the scapula to insert into the proximal humerus [1]. These four muscles are the supraspinatus, infraspinatus, subscapularis and teres minor [1] (Fig. 1). Each of these four muscles has a unique function, but they all work in synergy to provide stability to the glenohumeral joint (GHJ) [7]. Supraspinatus and infraspinatus arise from their respective fossa on the posterior surface of the scapula to insert into the greater tuberosity of the proximal humerus.

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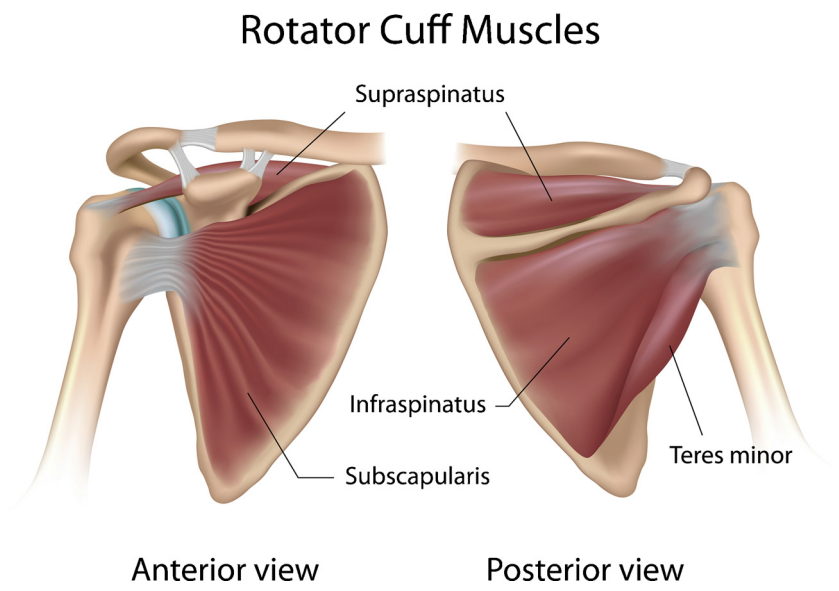

Fig. 1. Anatomy of the Rotator Cuff.

Supraspinatus forms the superior aspect of the cuff and is responsible for initiating abduction of the glenohumeral joint, whereas the infraspinatus is responsible for external rotation of the GHJ, along with teres minor [8]. Subscapularis is the largest of the cuff muscle and is responsible for internal rotation of the GHJ [7,8]. It arises from the anterior surface of the scapula to insert into the lesser tuberosity of the humerus. The teres minor originates from the middle third of the lateral border of the scapula and inserts into the greater tuberosity to assist in external rotation [8].

The GHJ is unique as only approximately 30% of the humeral head articulates with the glenoid fossa allowing for a highly mobile joint [9]. As a consequence, this makes the GHJ potentially unstable. During shoulder abduction, the rotator cuff unit acts to stabilise the shoulder joint by compressing the humeral head into the glenoid [9]. The humeral head is stabilised anteriorly by the subscapularis and posteriorly by the infraspinatus and teres minor unit, which act to prevent anterior and posterior translation of the humeral head respectively [1]. Furthermore, the bony architecture, labrum, ligaments and negative pressure within the shoulder joint all provide passive stability, whereas the rotator cuff and long head of biceps centre the humeral head into the glenoid and provide active stability [8]

4. Aetiology

Rotator cuff tears can be acute or chronic and partial or full thickness. Acute tears are normally seen in younger patients following a traumatic event such as a fall/dislocation. Chronic tears are seen in the elderly and are the result of age related degenerative processes. This article focuses on chronic RCTs.

Chronic RCTs result from a combination of intrinsic and extrinsic factors [1,8]. In 1931, Codman [10] described the intrinsic theory of RCTs. He hypothesised that degeneration occurs within a zone of hypovascularity which has poor regenerative properties. This zone is located within 10 mm from the insertion of tendon into bone. Repetitive stresses result in inflammatory changes causing tenocyte apoptosis, leading to a loss of structural integrity and eventual tear. Alternatively, the extrinsic theory proposed by Neer [11] in 1987 hypothesises that tears of the rotator cuff occur due to impingement from surrounding structures (such as the acromion) during normal arc motion, subsequently resulting in the continuum of impingement to partial and eventually full thickness tears.

The pathogenesis of rotator cuff tears in the elderly is complex and multifactorial, comprised of degenerative processes associated with aging, impingement and trauma [4]. Commonly rotator cuff tears will begin as partial thickness tears that increase in size over time due to intrinsic and extrinsic factors until they become a complete rupture [12]. The initial torn fibres are unable to participate in load sharing and the remaining fibres fail leading to tear propagation. This is especially true in older patients as tendon quality is initially poor [13]. Full thickness tears of the rotator cuff disrupt the joint mechanics leading to instability [14]. The force required to move the arm increases the tear size making the joint biomechanics less efficient [14]. With time, full thickness tears develop distinct chronic pathological changes including muscle atrophy, fatty infiltration and cuff retraction which can lead to osteoarthritis of the glenohumeral joint otherwise known as cuff tear arthropathy12.

5. Classification

Over the years numerous classification systems have been proposed to describe full thickness tears [1]. Three commonly used classifications systems are those by Cofield, Patte and Goutallier1. These classifications systems take into account tear size, degree of tear retraction and extent of fatty muscle atrophy respectively. Historically, rotator cuff tears that exceed 5 cm were identified as being a “massive rotator cuff tear”, however more recently this term has been reserved for those with a confirmed full thickness tear in at least two rotator cuff tendons [15]. Current literature suggests that the prevalence of elderly patients with massive rotator cuff tears is as high as 40% [13]. These tears are of clinical importance as are often more difficult to repair arthroscopically and may require more invasive procedures including tendon transfers and/or arthroplasty procedures.

6. Clinical assessment

The presence of a rotator cuff tear can often be suspected through a detailed history and careful examination which can then be confirmed by some form of imaging.

6.1. History

Elderly patients with rotator cuff disease often present with an insidious onset of shoulder pain, weakness or reduction in function [1]. Classically patients will describe pain that can be localised over the

anterolateral shoulder which is exacerbated by loading activities or overhead movements [16]. Patients who present with larger or massive tears primarily complain of reduced range of movement or pseudoparalaysis in the affected arm [13]. In patients who present with symptoms after minimal trauma it is highly likely that these patients had pre-existing asymptomatic tears [12].

6.2. Examination

The aim of a clinical exam is to help the physician confirm their suspicion of a rotator cuff tear [3,16]. The treating physician should perform a thorough shoulder examination which initially consists of a general inspection of the patient in the resting position to assess for any evidence of muscle wasting [16]. Both active and passive shoulder range of movement should be assessed as active movements may be reduced early on but passive movements may become limited especially with the onset of osteoarthritis [17]. In patients whom a superior or supraspinatus tear is suspected, forward elevation of the shoulder may be weak. In larger posterosuperior tears where infraspinatus and supraspinatus are both torn, external rotation and forward elevation are usually weak. In anterior or subscapularis tears, internal rotation may be weak.

6.3. Imaging

Imaging studies play a critical role in the diagnosis and selection of the most appropriate management. All elderly patients with presumed rotator cuff pathology should undergo shoulder x-rays to assess for any evidence of osteoarthritis, superior migration of the humeral head, avascular necrosis, osteoporosis or tumours1. The rotator cuff itself can be assessed with either Ultrasound (US) or MRI. US has the advantage of being a cost effective and easily accessible modality that can allow the physician to examine the shoulder joint in real time [12]. US can identify tear size and location; however, the information is highly subjective and operator dependent [12]. In a meta-analysis of 6066 ultrasounds assessing rotator cuff tears, a sensitivity of 84% and specificity of 89% partial and full thickness tears was demonstrated [18].

MRI is considered the gold standard imaging modality for the evaluation of the rotator cuff tendons [3]. MRI, as opposed to ultrasound can assess the entire rotator cuff musculotendinous unit. The presence of muscle atrophy and fatty infiltration can help to establish the chronicity of tears thus aiding in treatment decision [19]. Numerous articles have demonstrated that findings obtained from MRI highly correlate with arthroscopic findings [3]. Lenza et al. [20] found that MRI and US have similarly good diagnostic accuracy in the detection of full thickness rotator cuff tears. However, found that US had lower sensitivity compared to MRI for the evaluation of partial thickness tears

7. Conservative management

Many RCTs in elderly patients are either asymptomatic or minimally symptomatic and therefore no specific intervention is required [14]. Most symptomatic RCTs should also be managed conservatively and surgery can be considered after there has been a failure of non-operative treatment. There are numerous conservative management methods available which include exercise and physical therapy, corticosteroid and platelet rich plasma injections and regular analgesia. Petri et al. [14] demonstrated in their literature review that 75% of all patients who underwent conservative management were deemed “successfully” treated. When considering non-operative management, patient counselling and education is of particular importance. Patients who opt for non-operative management should be informed that conservative management is unlikely to cure or repair the tear, but rather improve symptoms and function [13]. It should be expressed that tears that are initially graded as reparable may become irreparable, and results of surgery after a failed non-operative treatment may be inferior compared to a primary repair [14].

7.1. Exercise and physical therapy

Exercise and manual therapy with guidance from a physical therapist is the most common first line treatment of choice in elderly patients with RCTs [5]. The main goal of physiotherapy is symptomatic relief and functional improvement [21]. A well-structured physical therapy regime should involve the re-education of muscle recruitment, scapular stabilisation, coordination of muscle contraction and improvement of proprioception [13].

Kuhn et al. [21] conducted a multicentre prospective study of 452 older age patients with full thickness rotator cuff tears and tracked their outcomes after a 3-month intensive physical therapy protocol. Successful outcomes were determined if after 2 years the patients did not proceed to have surgical management. The authors found that 74% of patients at follow up did not require operative management [21].

Mossmayer et al. [22] conducted a case control study that found only 17% of patients who underwent physical therapy elected to undergo surgical repair within the next 12 months. Herrmann et al. [3] demonstrated that elderly patients with massive rotator cuff tears undergoing a focused 3-month rehabilitation and strengthening program had significantly improved scores on the Oxford Shoulder Score as well as the Short Form Health Survey (SF-36) [3].

In a more recent prospective study, Colin et al. [23] followed 45 elderly patients with massive rotator cuff tears and associated pseudoparalysis for 2 years. After completion of a physical therapy program the authors found that patients had significantly improved active forward flexion in the shoulder from an average of 76 degrees to 160 degrees. This demonstrates the functional benefits obtained from physical therapy. Furthermore, it was found that 89% of these patients maintained their improvements at a 2 year follow up [23].

In a randomised control trial, Kukkonen et al. [24] compared three different management options for the treatment of isolated supraspinatus tears. Patients were randomly assigned to physiotherapy, physiotherapy and acromioplasty or rotator cuff repair, acromioplasty and physiotherapy. Patients were followed up at three, six and twelve months and the authors found no significant difference between the treatment groups at any stage of follow up. These results demonstrate that physical therapies can be effective at providing pain relief, functional improvement and improved patient satisfaction in elderly patients with RCTs when compared with operative repair.

7.2. Corticosteroid injections

The role of corticosteroid injections is controversial. Early studies made claims that corticosteroid injections have the ability to improve pain scores as well as function [25,27]. However, a systematic review by Koester et al. [26] established that subacromial corticosteroid injections only provided short term pain relief and were not thought to be effective in the overall management of rotator cuff tears. Similarly, Mohamadi et al. [28] conducted a meta-analysis comparing subacromial corticosteroid injections and placebo injections in patient with rotator cuff tendinosis. The researchers concluded that, at best, corticosteroids result in a minimal transient period of pain relief; however, they do not modify the natural course of disease. Furthermore, at a 3-month follow-up the authors found that, compared with placebo, corticosteroids did not result in reduced levels of pain. T

Thus, the evidence for corticosteroids in the management of RCTs is limited and has only been able to support their use as a source of short term analgesia. Furthermore, corticosteroid injections have associated cost, discomfort and risks such as joint infection, tendon weakening, localised bruising and mild increase in blood sugar levels. Therefore, corticosteroid injections can serve as a modality for pain relief facilitating physiotherapy. For this reason, they should be considered in with combination with physical therapy rather than a sole treatment

modality.

7.3. Platelet rich plasma

The injection of platelet rich plasma (PRP) for rotator cuff disease is a relatively new treatment modality. PRP is predominantly utilised as an adjunct to surgery or other forms of conservative management [5]. PRP is autologous blood that has been centrifuged to enrich the concentration of platelets that contain growth factors and cytokines which are believed to improve wound healing [29]. The platelets within PRPs are typically concentrated at much higher levels than whole blood [29]. Growth factors found in PRP include insulin like growth-factor-1(ILFG-1), platelet derived growth factor (PDGF), transforming growth factor B (TGF-B) and vascular endothelial growth factor (VEGF) which have all been implicated in the wound healing process [30]. Thus, PRP has been suggested as a method to enhance rotator cuff healing by accelerating the wound healing cascade [14]. Promising results have been obtained from in vitro studies for rotator cuff augmentation [5]. In tenocytes from degenerative rotator cuff tissue, PRP has been shown to increase cell proliferation and extracellular matrix synthesis [31]. Unfortunately, these results have not yet been translated into clinical studies.

Charousset et al. [32] compared patients who had a rotator cuff repair with and without PRP injections and found no difference in radiological or functional outcomes [32]. Similarly, a randomised controlled trial found no difference in tendon healing on subjective, functional and imaging assessments [33]. In a recent double blind study, 40 patients were randomised to PRP injections or normal saline whilst undergoing an exercise program [34]. At a 1 year follow up the authors found no difference in pain scores or shoulder range of motion between the two groups. Furthermore, Castricini et al. [35] conducted a randomised trial to assess the efficacy of addition of PRP injections to patients undergoing arthroscopic rotator cuff repair. The outcomes examined were postoperative difference in constant scores and integrity of the cuff tendon evaluated by MRI. The authors found no statistical between the groups in constant scores or tendon integrity. More recently, Carr et al. [36] investigated the tissue effects of the addition of PRP for patients who had undergone arthroscopic acromioplasty in patients with chronic rotator cuff tendinopathy. The authors found no difference in the Oxford Shoulder Scores between the two groups, however both groups had significant increases from 12 weeks onwards to their preoperative baseline, which is likely attributed to the operative component. PRP injections are thought to be relatively safe with the main risks being pain and localised infection. Rarely more severe complications may occur such as joint infection. While the use of PRP injections have increased, its effectiveness in the clinical setting of rotator cuff disease has not yet been shown to be of clinical benefit. At best PRP injections should be utilised in conjunction with other treatments.

8. Surgical management

Surgical repair of the rotator cuff is a cost-effective solution for symptomatic patients [12]. It may be considered after a failed trial of non-operative management [37]. In addition to the risks of surgery such as blood loss, infection and anaesthetic related issues, rotator cuff surgery complications may include; axillary nerve injury, joint infection, deltoid detachment, stiffness and re- tear.

8.1. Rotator cuff repair

Arthroscopic (or open) rotator cuff repair is currently one of the most common surgical procedures performed on the shoulder [17]. The aim of rotator cuff repair is to re-establish the tendon footprint by anchoring the torn tendon back onto the proximal humerus, specifically the greater tuberosity, to restore the force couples on the glenohumeral joint [12]. The repair should ideally be able to withstand all physiological and functional loads imposed on the GHJ [12]. A surgical repair is deemed successful if the shoulder biomechanics are restored, pain is decreased, function improved and the tendon has healed to the greater tuberosity [12].

Rotator cuff repair can be successfully achieved in the elderly population [5]. A study by Boehm et al[37] reported that the outcomes of rotator cuff repair in the elderly were comparable to that of younger patients. In a retrospective study evaluating the outcomes following arthroscopic rotator cuff repair in patients over the age of 75, the authors found significant clinical improvements postoperatively in visual analogue scale, University of California Los Angeles and constant scores [38]. Flurin et al. [39] conducted a prospective study of 145 patients over the age of 70 years who underwent arthroscopic rotator cuff repair and found significant improvements in all measured clinical outcomes scores at final follow up. In a prospective study by Verma et al. [40] of elderly patients undergoing arthroscopic rotator cuff repair, 94% of patients confirmed they were satisfied with their outcome after 2 years follow up. Grondel et al. [41] also found an 87% satisfaction rate after arthroscopic repair. Robinson et al. [42] conducted a prospective study to assess outcomes of rotator cuff repair in patients over the ago of 70. They were able to demonstrate an increase in constant scores from an average of 22.6 pre-operatively to 58.6 postoperatively. More recently, Carr et al. [43] conducted a randomised trial to assess the effectiveness of open and arthroscopic rotator cuff repair in patients over the age of 50 with degenerative rotator cuff tears. The researchers concluded that both open and arthroscopic repair resulted in improvement in the Oxford Shoulder Scores. Furthermore, they found no difference in clinical effectiveness between the two interventions at a 2 year follow up.

Compared with other surgical techniques, there is evidence to suggest superior outcomes are achieved with rotator cuff repair [44]. Franceschi et al. [45] prospectively compared the effectiveness of two surgical interventions for rotator cuff tears; one group receiving acromioplasty, cuff debridement and biceps tenotomy; the other arthroscopic cuff repair. Both groups demonstrated comparable results in regards to pain control however, cuff repair offered superior results in regards to improvement in range of motion, strength and overall function. These differences were hypothesised to be due to the ability of the rotator cuff repair to restore the anatomy and normal force couples of the shoulder.

These findings support the theory that cuff repair can lead to improved biomechanics resulting in improved pain and function. Rotator cuff repair has not only shown short term improvements in subjective scales but improved patient satisfaction and clinical outcomes at long term follow up.

8.2. Superior capsule reconstruction

Superior capsule reconstruction is a recently developed surgical technique for the treatment of massive irreparable rotator cuff tears [8]. The anterior capsule serves to maintain anterior glenohumeral stability whilst the posterior capsule plays an important role with posterior stability [8]. However, less is known about the superior capsule. The superior capsule attaches to a significant portion of the greater tuberosity with studies indicating as much as 61% of the total surface area [46]. As a result, it is often disrupted with complete tears of the supraspinatus or infraspinatus [46]. Ischihara et al. [47] conducted a biomechanical study and found defects on the superior capsule can lead to interrupted force couples and translation of the humeral head in all directions. Reconstruction of the superior capsule can restore superior translation of humeral head to that of a normal intact cuff [47]. Mihata et al. [48] assessed 23 patients who underwent superior capsule reconstruction and at 2 years follow up all clinical outcomes scores were improved. There was evidence that in 83.3% of patients, the grafts were intact at the time of follow up. The authors speculated that the superior capsule reconstruction restored anterior and posterior force couples and

thus is a viable option for patients with significant pain and reduced range of motion due to a massive rotator cuff tear.

8.3. Subacromial decompression

Subacromial decompression is an operation that may include all of or a combination of subacromial bursectomy, acromioplasty, debridement of torn tendon edges and release of the intra-articular portion of the long head of biceps tendon (LHB tenotomy)13. In larger cuff tears, the long head of biceps tendon is often the source of pain because it becomes entrapped between a proximally migrated humeral head and acromion [13]. This type of operative management may be considered ideal for the elderly patient with low functional demands or minimal weakness whose primary symptom is pain [13]. A contraindication to this type of surgery is pseudoparalysis and cuff tear arthropathy46. The aim of surgery is to alleviate pain and potentially improve pain related functional impairments [41].

Conflicting evidence exists regarding the overall benefit of subacromial decompression as a surgical option for rotator cuff tear. In a recent case control study, Inderhaug et al. [49] found no difference in pain related outcomes between patients receiving arthroscopic repair and subacromial decompression and those receiving subacromial decompression alone. Jaeger et al. [50] reported an overall satisfaction rate of 78.8% in patients who underwent subacromial decompression for partial thickness tears thought to be a result of impingement. However, in a retrospective study Jung et al. [38] found that subacromial decompression was ineffective for mitigating long term pain in older patients. A summary of current literature suggests that subacromial decompression can provide good initial pain relief that may assist in improved range of motion however there is ongoing concern regarding the long term benefits.

8.4. Reverse shoulder arthroplasty (RSA)

RSA is utilised in patients with massive rotator cuff tears (MRCT) with glenohumeral arthritis and intact deltoid function. Cuff tear arthropathy was initially defined by Neer11 in 1983 as a cuff tear with superior humeral head migration, erosion of the tubercles of the humerus and arthritic changes in glenohumeral articulation. RSA medialises and lowers the glenohumeral centre of rotation, increasing lever arm of the deltoid compensating for the ineffective rotator cuff [52]. Since 2008, the proportion of primary RSA procedures undertaken for rotator cuff arthropathy have increased from 21.1% to 36.7% in 2017 [53] Ortamier et al. [54] demonstrated that RSA is able to restore abduction and forward flexion when used for cuff tear arthropathy in elderly patients. Further, RSA has shown to be effective in patients older than 80 for improving pain scores, functional scores and shoulder range of motion [55]. Greenspoon et al[46] argued that RSA should be the main treatment of choice in patients with rotator cuff tears with pseudo paralysis even in the absence of osteoarthritis after a failed trial of conservative management.

Several studies have reported positive outcomes utilising RSA for the management of MRCT without glenohumeral arthritis. A recent systematic review Sevivas et al. [56] demonstrated that patients with MRCT had an overall improvement from preoperative to postoperative assessments in clinical scores of the shoulder, forward flexion, external rotation, function and pain. Wall et al. [51] found no difference in outcomes in patients who underwent RSA for MRCT without arthritis and those underwent RSA for cuff tear arthropathy, demonstrating that patients with MRCT and no associated osteoarthritis are able to achieve improvement in function and pain with RSA. Geary et al. [57] reported a 58% 10-year survivorship of the RSA prosthesis, therefore recommending RSA be reserved only for the elderly population.

It should be noted, RSA has specific associated risks and complication in addition to the general surgical risks of bleeding, infection, thrombus formation and anaesthetic related problems. In the 10 years following RSA patients have a cumulative risk of 6.4% of revision [53]. Instability/dislocation, followed by infection, loosening and fracture are the most common reasons for revision. Other risks include; pain, lysis, malposition, haematoma, synovitis and prosthetic breakage. Nevertheless, it is increasingly being utilised as an option for the management of massive cuff tears.

9. Conclusion

Rotator cuff tears are common with the prevalence increasing with age. In elderly patients, non-operative management is a first line approach with surgical management being reserved for those who fail a trial of conservative management. The current literature provides good results for rotator cuff repair in the elderly, RSA for rotator cuff tears in the presence of osteoarthritis and for massive cuff tears in the absence of osteoarthritis. Patients should be provided with all treatment options, operative and non-operative including their risks and likelihood of success, so they can make an informed treatment choice.

Contributors

Jess Micallef and Jay Pandya performed the literature review, wrote the manuscript and prepared it for publication.

Adrian K. Low was the senior author on the manuscript, and revised it prior to submission.

Conflict of interest

The authors declare that they have no conflict of interest.

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