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Superior Capsular Reconstruction in the Active Population with a Massive Irreparable Rotator Cuff Tear

Hernandez Emmanuel
University of North Dakota

Scholarly Project

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Emmanuel Hernandez PA-S

University of North Dakota

Professor Daryl Sieg, PA-C

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Abstract

The prevalence of rotator cuff tears is a leading cause of upper extremity functional disability and affects people across the lifespan. The primary age groups that are diagnosed include young adults as well as the elderly population. Early diagnosis and identification of rotator cuff injuries are paramount for the appropriate treatment to be facilitated. Approximately one-fifth of rotator cuff tears (RCT) are diagnosed as "massive" and prove to be difficult for orthopedic surgeons to repair. If the massive RCT is also diagnosed as "irreparable", surgical intervention is technically difficult and is a challenging procedure. Historically, treatment options have been limited for the young population to invasive surgical intervention or conservative measures such as physical therapy and pharmacologic measures. Surgical approaches to treatment may include a reverse shoulder arthroplasty (RSA) or a superior capsular reconstruction (SCR). The purpose of this study is to determine if a superior capsular reconstruction is a better alternative than a reverse shoulder arthroplasty in the young, active population with a massive irreparable rotator cuff tear. Currently, evidence-based practice proves that SCR is a viable treatment option in the younger population. An SCR has shown successful short-term outcomes and utilizes an anatomical approach. Each surgical option is feasible; however, the postoperative degree of functionality is the substantial difference between either surgical technique. Research has proven the efficacy of the SCR versus the RSA. Although there is limited current evidence-based research in the field of longevity and its potential outcomes, the SCR is the leading surgical option for massive irreparable rotator cuff tears repairs in the young, active patient.

Keywords: superior capsular reconstruction, reverse shoulder arthroplasty in young patients, massive irreparable rotator cuff tear

Introduction

Rotator cuff tears (RCT) are one of the most common upper extremity glenohumeral injuries seen in the orthopedic patient population. They are typically classified into four categories as either small, medium, large or massive. When a rotator cuff tear is classified as small, medium or large, rotator cuff tear repair is the treatment of choice. Historically, massive irreparable rotator cuff tears have had limited methods of treatment both conservatively and surgically. Interventions for massive irreparable rotator cuff tears generally consist of either a conservative course of physical therapy to strengthen the anterior deltoid, pharmacological treatment or a reverse shoulder arthroplasty (RSA). While an RSA is a viable treatment option, it is typically performed on the elderly patient and is considered an end-stage surgical treatment.

In this study, research and evidence based practice compare the two surgical techniques, their longevity, success, complications, and postoperative requirements. Sambandam, Khanna, Gul, & Mounasamy (2015), define the rotator cuff as tendons and muscles of the shoulder that provide joint stability and strength. The supraspinatus, infraspinatus, subscapularis, and teres minor are the four tendons that compose the rotator cuff. When torn or inflamed, patients experience pain, functional disability, and extremity weakness. A rotator cuff may be partially or fully torn and is diagnosed according to the degree of damage (Sambandam et al., 2015). Many risk factors for rotator cuff tear exist, including age, tobacco use, trauma, and advancement of degenerative progression (Sambandam et al., 2015). When the rotator cuff is diagnosed as massively torn and irreparable, surgical intervention is necessary to re-establish shoulder functionality and strength. In massive rotator cuff tears, tendons may retract from their insertion sites and pose a challenge to reinstate the tendons back to their insertion site. Muscle atrophy, fatty infiltration, and myotendinous retraction make it difficult for surgeons to completely repair

the rotator cuff (Mihata et al., 2013). Alternative methods are utilized to replace the rotator cuff or the entire shoulder joint. The age of the patient determines which surgical approach may be facilitated. The superior capsular reconstruction and reverse total shoulder arthroplasty present different postoperative results. The superior capsular reconstruction is a procedure to essentially restore the superior capsule and rotator cuff tendons which in turn stabilizes the glenohumeral joint (Mihata et al., 2013). A reverse shoulder arthroplasty replaces the glenohumeral joint with metal prostheses to reinvent the glenohumeral joint anatomy (Virk, Nicholson, & Romeo, 2016). It is crucial to perform a thorough physical exam and take a complete history to facilitate a more appropriate diagnosis and provide optimal treatment goals for the patient. The patient must always be involved in his or her treatment plan and have the knowledge to make sound decisions.

The databases utilized during the research of information regarding an arthroscopic superior capsular reconstruction and reverse shoulder arthroplasty were Pub Med and CINAHL. The searching criteria included research from the past five years addressing both surgical interventions of a reverse shoulder arthroplasty and superior capsular reconstruction. The articles facilitated for this project included systematic reviews, randomized control trials and observational studies.

Statement of the Problem

Conflict of interest arises when a young active patient endures a massive irreparable rotator cuff tear and surgical intervention is necessary for repair. A reverse shoulder arthroplasty and a superior capsular reconstruction are equally effective when treating rotator cuff tears. A comparative study between surgical interventions is necessary to determine success of restoration of shoulder function and overall longevity of the repair. Although each surgical

technique is potentially restorative, age of the patient is an important demographic detail that must be considered before determining a surgical treatment plan. In this study, a surgical technique will be acknowledged as superior for young, active individuals.

Research Questions

Is a superior capsular reconstruction a better alternative than a reverse shoulder arthroplasty in the young, active population with a massive rotator cuff tear?

Is a reverse shoulder arthroplasty a viable option for young, active patients with massive, irreparable rotator cuff tears?

Several surgical techniques have been developed for rotator cuff tears such as subscapularis tendon transposition, deltoid flap reconstruction, supraspinatus muscle development, pectoralis major transfer, and many others. Nevertheless, each surgical development has proven inferior and subpar regarding postoperative complications and clinical outcomes (Mihata et al., 2013). Specifically, this study focuses on two surgical techniques to repair massively torn rotator cuffs in young, active adult patients. The reverse shoulder arthroplasty is an older surgical technique and has shown promising outcomes but limited postoperative advancements. The superior capsular reconstruction technique has recently been developed but has its limitations. Definitive research must be performed to closely evaluate the advantages and disadvantages of each surgical technique to benefit the young, active adult. To better compare surgical interventions, a thorough literature review was conducted using current evidence based practice and further investigates the efficacy of a superior capsular reconstruction versus a reverse shoulder arthroplasty.

Literature Review

Methodology

The population criteria included in this study was young adults with a diagnosis of massive irreparable rotator cuff tears, who do not have a past medical history of shoulder surgery. The databases utilized during the research for information regarding an arthroscopic superior capsular reconstruction and reverse shoulder arthroplasty were Pub Med and CINAHL. Several articles were reviewed throughout the duration of this project. Search terms that were facilitated in Pub Med and CINAHL included: “superior capsular reconstruction”, “reverse shoulder arthroplasty in young patients” and “massive irreparable rotator cuff treatment”. This search yielded 163 studies and 133 were excluded due to surgical criteria, inadequate sample group and the publication year of the article. The searching criteria included the past five years in order to provide the most recent literature available. The articles utilized for this project included systematic reviews, randomized control trials and observational studies. One anatomy textbook was also used to implement appropriate anatomical and biomechanical information.

Anatomy and Physiology

The shoulder is considered the attachment that exists between the arm and the trunk of the body. The glenohumeral joint is a synovial ball and socket joint that consists of the head of the proximal humerus and the glenoid cavity of the scapula, which is often compared to a golf ball on a tee. The glenohumeral joint is multiaxial which allows for increased range of motion in forward flexion, extension, abduction, adduction, and internal and external rotation (Drake, Vogl & Mitchell, 2015). Due to the extensive range of motion of the glenohumeral joint, overall stability is compromised for mobility. Stability of the glenohumeral joint is provided by soft

tissue structures such as the rotator cuff musculature, the long head of the biceps brachii and various glenohumeral ligaments. A fibrocartilaginous structure called the labrum, lies within the glenoid cavity and increases the depth and surface area of the glenoid. The labrum provides increased resistance to humeral head translation and aids in overall stability of the glenohumeral joint. (Huegel, Williams & Soslowsky, 2015)

The rotator cuff is comprised of four muscles and tendons that include the supraspinatus, infraspinatus, teres minor and subscapularis. The supraspinatus plays a significant role in initiating shoulder abduction and is the most commonly injured component of the rotator cuff. The infraspinatus and teres minor are considered shoulder external rotators while the subscapularis is a shoulder internal rotator (Huegel et al, 2015). The rotator cuff is considered a dynamic stabilizer for the glenohumeral joint and assists in various shoulder movements (Petri, Greenspoon & Millet, 2015). Disruption of one or more of the rotator cuff tendons may cause multiple symptoms such as shoulder pain and a decrease in range of motion and strength. Further investigation by taking an adequate history and performing a thorough physical exam is pertinent to the evaluation of rotator cuff pathologies.

Individuals with rotator cuff tears experience pain at night due to subacromial impingement, decreased shoulder range of motion and decreased strength (Mihata et al, 2013). Patients find difficulty in initiating shoulder abduction and pain with resisted external rotation. Patients often recall a specific event that facilitated pain or may have a gradual onset of pain that has been precipitated by overuse through work or previous sport activity. Overall inspection of possible muscle atrophy particularly in the supraspinatus and infraspinatus fossa of the scapula, may be indicative of rotator cuff pathology. Special tests that may be positive when assessing for supraspinatus and infraspinatus involvement include a Drop Arm test and Jobe's Empty Can test

(Jain, Wilcox, Katz & Higgins, 2013). Teres minor involvement may be indicated by a positive Hornblower test. Assessment of the subscapularis can be achieved by performing Belly Press, Bear Hug or Lift Off test (Burkhart, Denard, Adams, Brady & Hartzler, 2016). A positive result to these diagnostic tests include eliciting pain during examination movements or an inability for the patient to complete the diagnostic test. Positive findings on physical exam of the shoulder may warrant diagnostic studies for further investigation such as x-rays and/or magnetic resonance imaging (MRI).

Radiologic images are excellent initial diagnostic studies to evaluate the shoulder and often include three views: anteroposterior (AP) view, lateral view and a Y scapular view (Thorness & Romeo, 2016). X-rays enable a provider to visualize shoulder alignment, superior migration of the humeral head in the glenoid fossa and the amount of glenohumeral osteoarthritis that may be present. In order to properly assess the soft tissue structure such as the integrity of the rotator cuff and its tendons, an MRI must be performed (Burkhart et al., 2016). An MRI can be performed with Gadolinium contrast media, however, performing the MRI without contrast is typically sufficient for diagnosis. An MRI allows a provider to evaluate the size of the rotator cuff tear, the amount of muscle atrophy and the acuity of the rotator cuff tear (Thorness & Romeo, 2016). Classifying the extent of the rotator cuff tear will be significant when determining the treatment plan as well as the prognosis for the patient.

One-fifth of diagnosed rotator cuff tears are initially found to be “massive” and have a high prevalence in recurrent rotator cuff tears (Ladermann, Denard & Collin, 2015). Various definitions exist when considering what truly classifies a rotator cuff tear as “massive”. Common diagnostic criteria used for determining whether a rotator cuff tear is massive depends on the dimension and size of tendon retraction. Typically, a tear that exceeds five centimeters in either

the anterior to posterior direction or the medial to lateral direction is considered massive (Ladermann et al., 2015). Another criterion that may denote a RCT as massive is the amount of associated tendon involvement. A complete tear of two or more rotator cuff tendons can also classify a tear as massive (Greenspoon, Petri, Warth & Millett, 2015). Another massive RCT diagnostic factor involves tendon retraction past the humeral head of one or more tendons (Ladermann et al, 2015). Although many massive rotator cuff tears are thought to be reparable, there is a percentage that still remain irreparable. Classifications exist that aid in the determination of reparability of a massive rotator cuff tear. Many include the irreversible severity of fatty infiltration or degeneration, which affects the function of the rotator cuff musculature (Ladermann et al, 2015). The correct diagnosis and classification of a RCT is paramount and plays a vital role in the treatment plan moving forward as well as the overall prognosis. Historically massive irreparable RCTs have been limited to a conservative treatment plan of cortisone injections and physical therapy or invasive surgical approaches such as a reverse shoulder arthroplasty. A RSA includes altering the anatomy of the shoulder to achieve restoration of shoulder function by using metal prostheses.

Reverse Shoulder Arthroplasty

A reverse shoulder arthroplasty (RSA) allows patients to resume functionality of the glenohumeral joint, however, this procedure is considered invasive and requires general anesthesia. Often performed in the geriatric population, this procedure is associated with its own complications. In any shoulder replacement, a metal ball and socket are placed in the glenohumeral joint to mimic the normal shoulder anatomy. In a reverse shoulder arthroplasty procedure, the ball and socket are “reversed” in the glenohumeral anatomy (Greenspoon et al., 2015). The glenoid or socket, is fixated to the proximal humerus and the ball is placed in the

glenoid of the scapula. A total shoulder arthroplasty is another surgical approach that is facilitated in patients with glenohumeral osteoarthritis and an intact rotator cuff pathology. This procedure mimics the normal anatomy of the shoulder and attempts to restore the normal kinematics of the glenohumeral joint (Virk, Nicholson & Romeo, 2016). A total shoulder arthroplasty utilizes the intact rotator cuff for strength and range of motion. In this study, the comparison of surgical procedures includes a reverse shoulder arthroplasty which is performed mostly in elderly populations, as well as a superior capsular reconstruction which is a newer surgical technique. Patients with an intact rotator cuff rely on the tendons and musculature of the rotator cuff for increased range of motion and strength, whereas patients with a massively torn rotator cuff rely heavily on the deltoid instead of the rotator cuff for increased functionality (Sevivas et al., 2017).

A reverse shoulder arthroplasty yields favorable outcomes in terms of pain reduction and stability. Compared to preoperative range of motion measurements, patients who undergo a reverse shoulder arthroplasty show increased range of motion postoperatively but continues to be very limited. Although, a reverse shoulder arthroplasty has shown positive results and can increase overall function, current studies suggest there are still many associated risks and complications that may occur. Intraoperative fractures may occur in the glenoid or proximal humerus as the prothesis is set, especially in patents who have a history of osteopenia. Surgical alterations that are made in the normal anatomy of the shoulder expose a patient to possible shoulder dislocations. This is due to the changes made in the lever arm of the deltoid musculature and typically occurs in abduction and extension of the shoulder (Barco, Savvidou, Sperling, Sanchez-Sotelo & Cofield, 2016). Complications of a reverse shoulder arthroplasty also may include loosening of hardware, wound hematoma or infection. Mechanical longevity of

a reverse shoulder arthroplasty is a concern and has been shown to be adequate for ten years postoperatively in the elderly population. Due to risks, complications and questionable longevity, the RSA procedure should be performed on elderly individuals. The RSA is reserved to provide stability but limits overall mobility due to the anatomical design and biomechanical changes (Virk et al., 2016). A reverse shoulder arthroplasty is now considered an "end of the road" treatment plan. The limited outcomes and functional dissatisfaction following a reverse shoulder arthroplasty outweigh the benefits of pain reduction and minimal shoulder range of motion especially in the young active population (Sevias et al., 2017). An alternative surgical technique is necessary for the younger population with irreparable massive rotator cuff tears who wish to continue to be active.

Superior Capsular Reconstruction

The superior capsule plays a significant role in the passive stability of the shoulder and reduces the incidence of translation within the glenohumeral joint. The superior capsule resides along the inferior surface of both the infraspinatus and supraspinatus tendons (Mihata et al, 2013). Disruption of the superior capsule that occurs with massive irreparable rotator cuff tears, causes destructive translations that can result in permanent damage to the articular surfaces of the glenohumeral joint (Ishihara et al, 2014).

Surgical criteria for the arthroscopic superior capsular reconstruction includes a massive irreparable RCT of the supraspinatus, a possible infraspinatus tear, an intact deltoid, and marginal osteoarthritis of the glenohumeral joint (Hirahara & Adams, 2015). This procedure consists of attempting to replace the tendons of the rotator cuff with allograft material. Allograft material is taken from a cadaveric donor and is tested for tensile strength which is measured to the appropriate size. Early surgical approaches utilized autograft tissue from the lateral fascia lata

of the patient who was enduring the procedure (Mihata, 2013). When beginning the SCR, three portals are made in the shoulder and include an anterior, posterior and lateral portal for arthroscopy. Prior to graft insertion, appropriate preparations are made which entail an arthroscopic decompression of the subacromial space to allow maximal clearance of the graft. Also, removal of bony spurs of the acromioclavicular joint and debridement of both the foot print of the greater tuberosity of the humerus and superior glenoid are performed (Petri, Greenspoon, Moulton & Millett, 2016). A partial rotator cuff tear repair of the infraspinatus tendon and/or the subscapularis tendon is attempted to aid in the stabilization of the superior capsule. Performing a partial rotator cuff tear repair in conjunction with a superior capsular reconstruction is viewed as an important step to restore normal kinematics (Sutter, Godin & Garrigues, 2017). The graft is attached to the superior glenoid with two suture anchors by passing it through the subacromial space. The lateral portion of the graft is then attached via a compression double row technique to the footprint of the greater tuberosity where the supraspinatus once resided (Narvani et al, 2016). Additional sutures may also be placed between the infraspinatus and the subscapularis for increased force coupling of the glenohumeral joint (Mihata et al., 2016). The rotator cuff is significant to the restoration of strength, but function can be restored by simply reconstructing the superior capsule (Hirahara & Adams, 2015).

Advantages of a superior capsular reconstruction include a strong and verified repair that allows for a prompt return of range of motion and will not sacrifice any future procedures since anatomic structures remain intact. A superior capsular reconstruction can be used as a bridging procedure which leaves the possibility for future arthroscopy if needed. Since any allograft is typically used, the patient does not have to worry about donor site pain or morbidity. Short term studies are proving excellent results and satisfaction rates among the young adult populations.

Long term efficacy of the superior capsular reconstruction is still under research (Tokish & Beicker, 2015). Disadvantages that arise with a superior capsular reconstruction include a technically difficult and lengthy procedure that must be performed by a competent orthopedic surgeon. Appropriate allografts may be difficult to obtain and can be costly (Hirahara & Adams, 2015). Also, a strict rehabilitation regimen must be followed to ensure the integrity of the graft is not disrupted during healing. Initially rehabilitation begins conservatively with the patient utilizing a postoperative abduction sling with pillow for the first six weeks. The patient is also instructed to keep the operative shoulder immobilized for six weeks. The reasoning behind immobility during the initial phase of rehab, is to protect the superior capsular graft at the expense of possible shoulder rigidity. Passive range of motion is initiated to the physical therapy regimen at six weeks postoperatively with strengthening exercises supplemented at twelve to sixteen weeks. (Adams, Denard, Brady, Hartzler & Burkhart, 2016). Even though an SCR is the recommended surgical treatment choice for a young adult with a massive irreparable RCT, alternative therapies exist for symptomatic treatment instead of surgical interventions.

Alternative Treatment Options

In many cases of a massive rotator cuff tear, surgical intervention is recommended, however, it is noteworthy to briefly mention conservative treatment options that may be pursued to reduce shoulder pain which ultimately increases range of motion and functionality. Alternative treatment options are indicated for patients who may not be candidates for surgical intervention (i.e. severe glenohumeral osteoarthritis) or who wish to refrain from operative treatments. Initial nonsurgical treatment options may include physical therapy with emphasis on anterior deltoid reeducation and strengthening of parascapular musculature (Yian, Sodl, Dionysian & Schneeberger, 2017). Physical therapy is initiated in an attempt to strengthen surrounding

shoulder musculature for the compensation of a torn rotator cuff. Physical therapy also teaches one how to manage activities of daily living without the strength and stability provided by the rotator cuff. A second alternative treatment option for pain control is a subacromial bursal or intraarticular glenohumeral injection of cortisone. Specifically, steroids such as Celestone provide the patient with symptomatic relief for up to six months' time (Wang et al., 2017). If an intra-articular injection fails long term pain relief and the reoccurrence of injections is more frequent, alternative treatment options should be enforced. Disadvantages to intra-articular steroid injections include overuse of steroid medications, results are usually short-term and do not fix the underlying issue, and injections are painful upon administration (Wang et al., 2017). Another conservative treatment option includes injectable hyaluronic acid that is also used for symptomatic treatment and can be repeated on an as needed basis. When injecting hyaluronic acid, a provider utilizes the same technique of intra-articular injections and places a band-aid over the injection site when finished. An additional conservative treatment measure is the use of oral nonsteroidal anti-inflammatory drugs such as naproxen, ibuprofen, diclofenac and celecoxib. These medications can be taken to relieve pain and may help improve tolerance of range of motion activities. When evaluating effectiveness of conservative treatment, one must consider how the patient responds to interventions and symptom reoccurrence (Itoi, 2013).

Conservative surgical procedures may also be performed to reduce symptoms and include subacromial decompression, glenohumeral debridement, biceps tenotomy, biceps tenodesis, and arthroscopy. Debridement involves an open procedure where the excision of loose soft tissue is performed. A study conducted by Solyar, Seeto, Chen & Mac Dessi (2016), proved that debridement aids in pain reduction but the goal of improving range of motion and functionality was negated. Subacromial decompression is another surgical intervention that revealed the same

results as a rotator cuff debridement as far at pain reduction and a minimal increase in range of motion (Solyar et al., 2016). A shoulder arthroscopy may be performed to investigate myotendinous pathologies that may be causing pain or weakness. Although this study focuses on two effective surgical techniques, alternative treatment options should be acknowledged. Many patients with irreparable rotator cuff injuries decide to continue conservative treatment options in order to avoid the hassle and inconvenience of surgery. Patients should be thoroughly educated on the risks and benefits of treatment options, both surgical and non-surgical. Providers should take the time to build trusting patient relationships and investigate treatment options that are individualized and beneficial for the patient. Complete and thorough knowledge of surgical techniques is required in order to advise patients in the direction that is best recommended for their future goals and wishes. A complete discussion of research conclusions and study results is followed and directs an evidence-based plan of care that is of superior practice.

Discussion

Thorough research and investigation has been performed and is evident that a reverse shoulder arthroplasty and a superior capsular reconstruction are equally viable treatment options for patients with massive irreparable rotator cuff tears. The reverse shoulder arthroplasty is an artificial reconstruction of the glenohumeral joint that is made with metal prostheses. Ultimately this surgical technique alters the normal anatomy and functionality of the glenohumeral joint, which poses many complications and risks. The superior capsular reconstruction on the other hand, is a surgical technique that preserves the original anatomy and integrity of the glenohumeral joint. The SCR utilizes graft placement to re-create the rotator cuff and is proven to increase strength and functionality without compromising normal shoulder anatomy. Study

results compare the long-term efficacy of each surgical technique and rely heavily upon the patient's age and level of activity.

Is a superior capsular reconstruction a better alternative than a reverse shoulder arthroplasty in the young, active population with a massive rotator cuff tear?

With the introduction of a superior capsular reconstruction, patients can experience an anatomical surgery that will reduce pain and increase functionality without compromising future surgical interventions. In a study conducted by Mihata et al. (2013), 223 patients with rotator cuff tears for which conservative treatment failed, underwent arthroscopic shoulder surgery by a single surgeon. Twenty-five of those patients forewent an arthroscopic superior capsular reconstruction. The SCR surgery resulted in a two-fold increase in shoulder range of motion from preoperative measurements and had minimal complications (Mihata et al., 2013). Previously, patients with massive irreparable tears have undergone a reverse shoulder arthroplasty with success. Unfortunately, literature reveals that an RSA changes the normal anatomy of the glenohumeral joint and has shown poor longevity in younger patients. Recent literature has shown success by performing an SCR, which recreates the superior capsule of the glenohumeral joint and restores normal biomechanics to the shoulder. It is anticipated that an SCR will be the superior alternative for patients that are too young to endure a reverse shoulder arthroplasty.

Denard et al. (2017), performed a study to evaluate the short-term outcomes of superior capsule reconstruction that utilized a dermal allograft to repair massive rotator cuff tears. The authors believed the dermal allograft limits donor site morbidity and has long term pathologies of strength (Denard et al., 2017). The mean age of participants in this study was 62 years of age who were still active. A minimum of one-year follow-up was ensued when results were gathered

and calculated. Patients had improved forward flexion by twenty-eight degrees and improved external rotation by nine degrees postoperatively (Denard et al., 2017). Patients also experienced improved pain scores and overall shoulder functionality scores using the American Shoulder and Elbow Surgeons (ASES) scale. The patients underwent an MRI at the postoperative follow up visit to check the integrity of the dermal graft. The authors concluded that a superior capsular reconstruction in the healthy, active adult using a dermal allograft revealed that seventy percent of cases were successful (Denard et al., 2017). As in other studies that were analyzed during this study, evidence is lacking for the long-term efficacy of the superior capsular reconstruction.

Another study was performed by Nishinaka et al. (2016) to investigate the clinical outcomes and MRI results of patients who had undergone a superior capsule reconstruction for irreparable rotator cuff tears. Physical examination, range of motion measurements, clinical rating system and an MRI was performed pre-operatively, at six and twelve months postoperatively, and every subsequent six months. The utilization of the American Shoulder and Elbow Surgeons index was enforced preoperatively as well (Nishinaka et al., 2016). As in the results of the study conducted by Denard et al. (2017), Nishinaka et al. discovered improved active elevation and external rotation measurements compared to preoperative standards. In this study, there was a case of surgical infection which resulted in graft failure. Five patients who followed up had a torn graft which altered the complete count of participants in this study (Nishinaka et al., 2016). It is noteworthy that postoperative range of motion in the healed population sample was increased significantly for the participants who underwent a superior capsule reconstruction.

Although the superior capsule reconstruction is a newer surgical technique, more studies are being performed on the efficacy and clinical outcomes of this turn key operation, which is

proving successful and favorable. A study composed by Hirahara, Andersen, and Panero (2017) investigates clinical outcomes two years postoperatively after a superior capsular reconstruction. The authors note the narrow operative options that have been historically facilitated for rotator cuff pathology such as debridement, biceps tenotomy, partial rotator cuff repair, bridging patch grafts, and many more (Hirahara et al., 2017). Mihata, is known as the founder of the superior capsular reconstruction and recognized the ineffectiveness and suboptimal benefits of each historical technique including the reverse shoulder arthroplasty. Hirahara et al. (2017) researched Mihata's surgical technique and constructed a study of their own. Their study compared a reverse shoulder arthroplasty with a superior capsular reconstruction and had statistical proof that the SCR has fewer risks and complications than the RSA. Of utmost importance is the knowledge that superior capsular reconstruction does not sacrifice future surgical intervention if needed (Hirahara et al., 2017). Hirahara favored the use of a dermal allograft as did Denard et al. (2017) and yielded the same successful results. However, Hirahara et al. (2017) concluded that graft tension is the gold standard to the superior capsular procedure. They believed graft tension is necessary to govern the level of elasticity allowed by the graft which maintains stability (Hirahara et al., 2017). In conclusion, this study proves that the SCR can effectively restore superior range of motion in the shoulder when executed with precision, even after two years postoperatively (Hirahara et al., 2017).

In an article written by Thorsness and Romeo (2016), a thorough inspection of the surgical management of massive rotator cuff tears reveals the superior capsule reconstruction as the superior technique for young and active individuals. Specifically, the authors note the necessity of a reverse shoulder arthroplasty for older, "lower demand" patients who have pseudoparalysis and rotator cuff pathologies (Thorsness & Romeo, 2016).

The superior capsular reconstruction surgical technique is a newer addition to the many techniques of massive rotator cuff tear repairs and proves successful in each up to date study. Due to the superior capsular reconstruction being a newer surgical method, orthopedic surgeons may have less knowledge of the procedure and rely on the reverse shoulder arthroplasty which is a procedure most surgeons have mastered. Although there have been many successful short-term outcomes that are evident in literature, there may be inadequate longitudinal evidence available to prove long-term efficacy of an SCR. Common surgical practices may be affected by the newness of the SCR procedure. The SCR procedure method is new research and has thus far warranted successful and promising results for patients with massive rotator cuff tears. There are some discrepancies as to the graft choice utilized in the SCR procedure. Graft options include either a tensor fascia lata autograft or a human dermal allograft. The study population is selected based on concrete criterion that may include or dismiss their involvement in the studies which eliminates the possibility of skewed research results.

In contrast, Sevivas et al. (2017), performed a systematic review with meta-analysis and meta-regression to quantitatively collect findings associated with a reverse shoulder arthroplasty and its effect on patient function and pain. The inclusion criteria for this study were patients who indicated the need for a reverse shoulder arthroplasty and presented with moderate to severe persistent shoulder pain, decreased range of motion despite six months of conservative therapy, and damage to two rotator cuff tendons (Sevivas et al., 2017). It is noted in this study that a reverse shoulder arthroplasty reduces pain which is exchanged for deceased functionality. External and internal rotation of the shoulder remain limited after an RSA is performed (Sevivas et al., 2017). The RSA is not without consequences which include complication rates as high as one in five RSA procedures. The revision rate of the prostheses is approximately one in twelve

patients at short to medium term (Sevivas et al., 2017). In this study, it is recommended that this procedure be reserved for elderly individuals who are not as active and have failed conservative treatment interventions. An RSA may result in excellent pain reduction for patients with a massive rotator cuff tear but may only slightly improve functional status of the shoulder.

A recent study was performed by Samuelsen et al. in 2017 that focused on the RSA in patients sixty-five years or younger. The authors note that an RSA is an effective treatment option for many diagnoses in "elderly patients" (Samuelsen et al., 2017). It is noted that between surgical technique evolvement and innovative implant design, reverse shoulder arthroplasties have been utilized in younger populations. Studies acknowledge that the high complication rate and the decline in clinical outcomes deters younger patients away from the RSA procedure. Samuelsen et al. (2017) believe that literature has cited increased rates of complications and revisions which limit the use of an RSA as an optimal treatment option (Samuelsen et al., 2017). This article also explains that implant failure can also be caused by tobacco use, which ultimately leads to revision. Samuelsen et al. (2017) state that the RSA is a viable treatment option for patients sixty-five years and younger due to the development of the implant which is made to survive greater than ten years.

A comprehensive study to compare a reverse shoulder arthroplasty and a superior capsular reconstruction was performed by Angelo, Sobral, and Azevedo in 2017. Several treatment options are mentioned for an irreparable massive rotator cuff tear which include conservative treatment (physical therapy, muscular strengthening, nociception), tenotomy/tenodesis, suprascapular nerve decompression, tendon transfer, reverse arthroplasty and an arthroscopic superior capsular reconstruction (Angelo et al., 2017). In their study, 17 patients were diagnosed with an irreparable massive RCT. Two patients were excluded for

infection and an associated tendon transfer option which left eight patients who underwent a RSA (Group 1) and seven patients who experienced an SCR with a fasia lata autograft (Group 2). According to age and gender, both group one and group two results were equal. Each technique proved to result in similar functionality measures. The SCR decreases the incidence of loss of active internal rotation in adduction compared to the RSA, which is critical when performing activities of daily living (Angelo et al., 2017). According to this study and many others, the SCR has less complications and the outcomes are successful and positive.

Is a reverse shoulder arthroplasty a viable option for young, active patients with massive, irreparable rotator cuff tears?

A reverse shoulder arthroplasty is a viable option for young, active patients who are diagnosed with a massive irreparable rotator cuff tear. There are risk factors and complications with every surgery and current literature suggests the RSA has higher rates of revision and complications than the SCR (Sevivas et al., 2017). As mentioned previously, the reverse shoulder arthroplasty in the introduction of a metal implant into the glenohumeral join to reconstruct the anatomy of the shoulder. The implant is made to survive greater than ten years, however hardware loosening and increased rates of revision are reported (Samuelsen et al., 2017). The RSA reduces pain and limits overall shoulder functionality. The normal anatomy of the shoulder is compromised and limits the ability for surgical intervention in the future if necessary. The RSA is considered an “end of the road” treatment option which is reserved for the elderly who are typically less active (Sevias et al., 2017). If a young active adult is to reinjure his or her shoulder after an SCR is performed, surgeons are able to repair tendons and musculature as necessary.

In summary, through extensive research and investigation, it is apparent that the superior capsular reconstruction is a superior treatment option when compared with the reverse shoulder arthroplasty. Although the graft that is utilized in the SCR procedure may be difficult to locate and can be expensive, the postoperative outcomes outweigh the risks. There are more disadvantages from the RSA than there are advantages and satisfaction rates. In all studies, a significant increase in shoulder range of motion was significantly marked after a superior capsular reconstruction. The SCR maintains the normal anatomy of the shoulder but reinforces it with tendon repair so that patients will regain their strength and stability (Mihata et al., 2013). Patients who undergo a reverse shoulder arthroplasty compromise the natural state of the glenohumeral joint and exchange pain reduction for lifelong limited mobility. An RSA sacrifices the opportunity for future surgical procedures if ever indicated. Studies have shown an increased rate of complications and revisions for patients who undergo an RSA. The young, active population has the potential to reinjure their shoulder with activity but can be repaired even with a history of a superior capsular reconstruction if indicated. An SCR is a less invasive surgical procedure and postoperative results are extremely promising. More research is warranted to determine the long-term postoperative outcomes for each surgical technique, however recent studies show promising results for those who choose to pursue a superior capsular reconstruction.

Applicability to Clinical Practice

Shoulder injuries are extremely prevalent and account for a majority of orthopedic related visits within primary care settings. It is estimated that there are at least a quarter of a million rotator cuff tear repairs performed throughout the United States annually with twenty to forty percent of all tears being classified as massive (Sutter et al., 2017). Challenges occur when an

irreparable massive rotator cuff is diagnosed in a young active individual. Historically, treatment options have been limited to invasive orthopedic surgeries or conservative treatment plans that included physical therapy and pharmacological treatment. With recent advances in orthopedics surgery, it is evident that alternative options have been made that may restore functionality, improve strength and reduce pain in these individuals. It is important to educate patients on the various treatment options associated with massive irreparable rotator cuff tears. It is vital to individualize each treatment plan that best suits the patient's needs and long-term goals.

A reverse shoulder arthroplasty has been the treatment of choice in the past for individuals with massive irreparable rotator cuff tears. Although an RSA has been shown to be effective in reducing pain and improving functionality, it has typically been reserved for the elderly population. An RSA is a technically invasive procedure that changes the overall anatomy of the glenohumeral joint and is often pursued once all other conservative options have been exhausted. This reservation is due to the adverse effects and questionable longevity that arises with extended use such as prolonged wear of the prosthesis, prosthetic loosening or subsequent dislocations (Barco et al., 2016). Short term studies have shown acceptable outcomes, however long-term efficacy in the young active population has not been studied.

With recent changes in orthopedic surgical techniques, the superior capsular reconstruction is an anatomical approach for irreparable rotator cuff tears that has emerged. Using either autograft or allograft tissue, the superior capsule is reconstructed to mimic the function of the deficient rotator cuff. An SCR is often performed in conjunction with a subacromial decompression and/or a partial rotator cuff tear repair to offer additional support to the superior capsule (Anley, Chan & Snow, 2014). Early studies have shown acceptable outcomes and excellent efficacy, however due to its recent introduction this procedure lacks

sufficient longitudinal studies. Complications of a superior capsular reconstruction include graft failure, a technically difficult procedure for an orthopedic surgeon and poor adherence to the associated rehabilitation program. Unlike the reverse shoulder arthroplasty, a superior capsular reconstruction utilizes an anatomical approach and allows for additional shoulder surgeries if necessary.

Throughout the research it was found that both a reverse shoulder arthroplasty and a superior capsular reconstruction yield acceptable short-term outcomes but still contain many long-term questions. It appears that a superior capsular reconstruction is emerging as the optimal surgical procedure for young active individuals with massive irreparable rotator cuff tears and will continue to gain popularity in the future.

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