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Management of Rotator Cuff Injuries: Surgical Repair vs. Conservative Treatment

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ABSTRACT
Rotator cuff injuries are a common cause of shoulder pain and dysfunction, resulting from acute trauma or degenerative changes. These injuries, including partial and full-thickness tears, can significantly impair daily activities and reduce quality of life. Treatment options range from conservative measures, such as physical therapy and NSAIDs, to surgical interventions like arthroscopic repair. The choice of treatment depends on factors such as tear size, patient age, and activity level. This review compares the effectiveness of conservative treatment and surgical repair for rotator cuff injuries, focusing on pain relief, functional recovery, and complication rates.
Conservative treatment is typically the first-line approach for partial-thickness tears or patients with lower physical demands. Physical therapy and nonsteroidal

anti-inflammatory drugs are common modalities that can improve symptoms, particularly for smaller tears. Corticosteroid injections are also used to provide short-term relief, although their long-term benefits are less clear. For larger or full-thickness tears, surgery is often necessary due to the risk of progressive degeneration and persistent symptoms. Arthroscopic repair is particularly beneficial for younger or more active patients, offering superior long-term outcomes in terms of strength and function.
Studies indicate that while conservative treatment and surgery may offer similar short-term outcomes for smaller tears, surgery provides better long-term recovery for more extensive injuries. Ultimately, the decision between conservative and surgical treatment should be individualized, considering tear size, patient age, activity level, and overall health. Surgery is recommended for full-thickness tears or when conservative treatment fails to yield sufficient improvement, while conservative management remains effective for many smaller tears.

Keywords
partial thickness rotator cuff tear, surgical management, surgical repair, minimally invasive surgery, non-pharmacological interventions, non-pharmacological therapy

Introduction

Rotator cuff injuries are among the most common causes of shoulder pain and dysfunction, significantly impacting an individual's ability to perform daily activities and reducing their overall quality of life. These injuries can occur due to acute trauma, such as a sudden fall or accident, or as a result of degenerative changes that progress with age and repetitive overhead activities. Rotator cuff injuries typically involve partial or full-thickness tears of the tendons, which attach the muscles of the rotator cuff to the bones of the shoulder. Partial tears refer to fraying or incomplete tearing of the tendon, whereas full-thickness tears involve a complete detachment of the tendon from its bony attachment. Both types of tears can cause pain, weakness, and a reduced range of motion, although full-thickness tears generally result in more significant functional impairment.

The treatment options for rotator cuff injuries span a wide spectrum, from non-surgical (conservative) interventions such as physical therapy and pharmacological management to surgical repair, particularly in cases of severe or full-thickness tears. The optimal treatment approach depends on a variety of factors, including the severity and size of the tear, the patient's age, activity level, overall health, and their personal preferences regarding treatment outcomes and recovery time. Given the diversity of treatment strategies, it is critical to evaluate the relative effectiveness of conservative versus surgical interventions to provide clinicians with evidence-based guidelines for managing these injuries.

This review assesses the effectiveness of surgical repair versus conservative treatment for rotator cuff injuries by examining key outcome measures, including pain relief, functional improvement, recovery time, and complication rates. The goal is to offer guidance on selecting the best treatment approach for individual patients based on current clinical evidence.

Aim

The primary aim of this paper is to compare the clinical outcomes of conservative treatment versus surgical repair for rotator cuff injuries, with a focus on providing evidence-based recommendations for clinicians. Key outcomes such as pain relief, restoration of shoulder function, recovery time, and the incidence of post-treatment complications are evaluated. By synthesizing the available research, we aim to determine under what circumstances surgical intervention is necessary and when conservative management may suffice. Additionally, we explore the potential benefits of emerging treatment options and their place in current practice.

State of Knowledge

Conservative treatment is generally the first-line approach for patients with partial-thickness rotator cuff tears or for those with lower activity levels and fewer physical demands. Conservative management typically includes physical therapy (PT), nonsteroidal anti-inflammatory drugs (NSAIDs), and corticosteroid injections. Physical therapy focuses on strengthening the rotator cuff muscles and scapular stabilizers to improve shoulder stability and function. Studies have shown that a structured physical therapy program can yield significant improvements in both pain and functional capacity, especially in patients with smaller, partial-thickness tears. In these cases, conservative treatment may reduce symptoms enough that surgery can be avoided altogether, especially in older adults or those with lower functional needs.

NSAIDs are commonly prescribed to reduce pain and inflammation in the affected shoulder. While they do not directly address the underlying tendon pathology, they can offer symptomatic relief, improving the patient's comfort during the rehabilitation process. Corticosteroid injections, meanwhile, can provide more immediate relief by reducing inflammation within the joint, although their long-term efficacy remains debated, and repeated use may weaken the tendon tissue over time.

For full-thickness rotator cuff tears, conservative treatment may still be attempted, particularly in older or less active patients who are not ideal candidates for surgery. However, the risk of further degeneration and a decrease in shoulder function is greater in full-thickness tears, especially if conservative measures fail to provide sufficient relief after several months of treatment. Studies have shown that patients with full-thickness tears who do not respond to conservative treatment often experience progressive tendon damage, which may necessitate surgical intervention to prevent further deterioration.

Surgical repair, particularly through minimally invasive arthroscopic techniques, is typically recommended for larger or full-thickness tears, especially in younger or more physically active individuals. Arthroscopic surgery offers several advantages over traditional open repair, including smaller incisions, reduced tissue trauma, and faster recovery times. Research has demonstrated that surgical repair, particularly when performed early in the course of the injury, can restore shoulder strength and function more effectively than conservative treatments. Surgery may be especially beneficial for athletes or individuals whose occupations involve heavy physical labor or repetitive overhead movements, as it provides more robust and long-lasting results.

Several studies suggest that while conservative treatment and surgery may yield comparable short-term outcomes for smaller tears, surgical repair generally provides better long-term recovery for patients with more extensive tears. One meta-analysis found that approximately 90% of patients who underwent arthroscopic rotator cuff repair reported significant functional improvements and pain relief. Moreover, younger patients and those with active lifestyles tend to experience the greatest benefits from surgical intervention. However, the risk of complications, such as re-tears, remains a concern, particularly for older patients or those with large, chronic tears.

Emerging treatment options, such as biologic augmentation, platelet-rich plasma (PRP) injections, and stem cell therapies, have shown promise in promoting tendon healing and regeneration. Biologic augmentation involves the use of growth factors or scaffolds to enhance the body’s natural repair processes. While

these treatments are still in the experimental phase and their long-term efficacy remains uncertain, they offer a potential alternative to surgery for certain patients, particularly those with partial-thickness tears or chronic injuries. Future research may provide further insights into the role of these innovative therapies in the management of rotator cuff injuries.

Summary (Conclusions)

The choice between conservative treatment and surgical repair for rotator cuff injuries must be tailored to the individual patient, with careful consideration given to factors such as the size of the tear, the patient's age, activity level, and overall health status. For patients with partial-thickness tears, particularly those with lower physical demands or advanced age, conservative treatment, including physical therapy and NSAIDs, often provides sufficient relief and functional improvement, particularly in the short term. Conservative management is also favored for patients who are not suitable candidates for surgery due to comorbidities or personal preference.

However, for larger or full-thickness tears, particularly in younger or more physically active individuals, surgical repair—especially using minimally invasive arthroscopic techniques—tends to offer superior long-term outcomes. These outcomes include greater pain reduction, strength restoration, and improved overall shoulder function. Surgery is particularly beneficial when conservative treatment has failed or when there is a high risk of progressive tendon degeneration and loss of shoulder function. Furthermore, surgical repair may reduce the risk of symptom recurrence and further tendon damage, especially for extensive injuries.

While conservative and surgical treatments may offer similar short-term benefits for smaller tears, surgical intervention is generally more effective in providing durable results for more extensive injuries. Ultimately, the decision-making process should involve a thorough assessment of the risks and benefits of each treatment option, alongside consideration of the patient's preferences, activity level, and long-term goals. A personalized treatment plan that balances the advantages of conservative and surgical options will help optimize long-term outcomes and improve the patient's quality of life. Emerging biologic therapies may play an increasing role in the future of rotator cuff treatment, potentially offering less invasive solutions for specific patient populations.

Key words:

Partial thickness rotator cuff tear, surgical management, surgical repair, minimally invasive surgery, non-pharmacological interventions, non-pharmacological therapy

INTRODUCTION

Rotator cuff injuries are prevalent, particularly among middle-aged and older adults, contributing to shoulder pain, disability, and reduced quality of life. The rotator cuff is composed of four muscles and tendons that surround the shoulder joint, providing stability and enabling a wide range of movements. Injuries to the rotator cuff can arise due to trauma, degenerative changes, or repetitive overhead activities. Treatment strategies range from conservative measures, such as physical therapy and corticosteroid injections, to surgical repair for more severe cases. The choice between conservative and surgical management depends on factors such as the extent of the injury, patient age, activity level, and symptom severity.(Xu et al., 2024)

Definition, Epidemiology, and Characteristics

Definition

Rotator cuff tears (RCTs) are categorized into partial-thickness and full-thickness tears. Partial-thickness tears involve fraying or incomplete tearing of the tendon, while full-thickness tears are characterized by complete separation of the tendon from its attachment to the humerus. Full-thickness tears often result in significant pain and functional impairment, necessitating more aggressive treatment approaches.(Chambers et al., 2024)

Epidemiology

Rotator cuff tears are among the most common shoulder injuries, with increasing prevalence in older adults. Studies suggest that 20% to 30% of individuals over 60 years of age have some degree of rotator cuff tear, although many cases remain asymptomatic. The incidence of symptomatic tears increases with age, with degenerative tears being more common in the elderly due to tendon wear and microtrauma. Traumatic tears, however, are more prevalent in younger individuals engaged in high-demand activities, such as sports or manual labor.(Chambers et al., 2024)

Characteristics

Patients with rotator cuff tears often present with pain, especially during overhead activities or at night, as well as weakness and restricted range of motion. Full-thickness tears are typically associated with more profound functional impairment compared to partial. Tears may be classified as either traumatic—resulting from an acute injury—or degenerative, which develop

gradually due to chronic overload or aging-related degeneration. (Dubé et al., 2024; Lafrance et al., 2024; B. Zhang et al., 2024)

Treatment Approaches

Conservative Treatment

Conservative treatment is the first-line option for many patients, particularly those with partial-thickness tears or low activity demands. Key components include:

Physical Therapy (PT): PT aims to strengthen the scapular stabilizers and rotator cuff muscles, improving shoulder function. Studies report success rates of up to 80% in patients with partial-thickness tears who undergo a comprehensive physical therapy regimen.

Nonsteroidal Anti-inflammatory Drugs (NSAIDs): These are frequently prescribed to manage pain and inflammation. NSAIDs provide symptomatic relief, but they do not address the underlying tendon pathology.

Corticosteroid Injections: These are effective in reducing inflammation and pain, providing temporary relief for patients with significant symptoms. However, repeated injections can increase the risk of tendon degeneration, and their long-term efficacy is uncertain.(Longo et al., 2012)

Conservative treatment can yield favorable outcomes, particularly in older adults and patients with partial tears. However, full-thickness tears, especially in younger and active individuals, may require surgical intervention if conservative measures fail to relieve symptoms after several months,

Surgical Repair

Surgery is typically indicated for full-thickness tears, especially in active patients or when conservative management has failed. Surgical techniques vary based on the tear's size and location: Arthroscopic Repair: A minimally invasive procedure that utilizes small incisions and cameras to repair the torn tendon. Arthroscopic repair has gained popularity due to its reduced morbidity and faster recovery compared to open surgery. Open Repair: This traditional method involves a larger incision and direct visualization of the tendon. While associated with a longer recovery period, it may be necessary for complex or large tears. Mini-Open Repair: Combines arthroscopic techniques with a smaller incision, allowing for direct tendon repair with minimal tissue disruption. This method is often used for medium-sized tears.(L. Zhang et al., 2024)

Surgical repair generally provides good to excellent outcomes, particularly for younger patients and those with full-thickness tears. A meta-analysis reported that approximately 90% of patients experienced significant functional improvement following rotator cuff repair, although the risk of re-tears remains, especially in larger tears or older patients(Kim et al., 2024)

Anatomy

The rotator cuff consists of four muscles and their tendons: the supraspinatus, infraspinatus, teres minor, and subscapularis. These muscles originate from the scapula and insert onto the humeral head, forming a "cuff" around the shoulder joint. The primary function of the rotator cuff is to stabilize the shoulder joint and facilitate movements such as arm elevation and rotation. The supraspinatus, which is most commonly involved in rotator cuff tears, lies beneath the acromion and is susceptible to impingement during overhead activities.

Rotator cuff injuries typically occur at the tendon's insertion onto the humerus, with the supraspinatus tendon being the most frequently involved due to its location and poor vascular supply. Degenerative changes, including tendon thinning and microtrauma, predispose the rotator cuff to injury, particularly in older individuals.

Risk Factors

Patients under 50 years of age with a rotator cuff tear (RCT) are more likely to experience traumatic injuries. These traumatic tears are often full-thickness, occur predominantly in men, and are frequently associated with work-related incidents. In contrast, rotator cuff tears in older individuals, typically over 40, are more commonly degenerative, developing gradually due to natural tendon wear and tear. This is especially true for individuals involved in repetitive overhead movements, such as those in physically demanding professions or athletes in sports like baseball and swimming.

Comorbidities such as hypertension, hyperlipidemia, and smoking status were not found to have statistically significant effects on the development of RCTs in this analysis. However, it may be beneficial for future studies to explore the potential role of medical conditions like diabetes and arthritis, which are known to impair tendon health and healing, particularly in atraumatic tears. Understanding the interplay between these comorbidities and rotator cuff injuries could lead to more targeted treatment strategies for specific patient populations.(Chambers et al., 2024)

Traumatic rotator cuff tears tend to occur more often in men, especially those engaged in manual labor or high-impact sports, pointing to the importance of

gender and occupation as risk factors. Additionally, individuals who delay treatment of minor shoulder injuries face an increased risk of developing more severe, chronic conditions. This delay can lead to larger tears, which are harder to repair and often require more invasive treatments. Rehabilitation is another key factor in recovery, as inadequate physical therapy and failure to properly strengthen the shoulder muscles after an injury can significantly increase the likelihood of reinjury.

Anatomical factors, such as a naturally narrow subacromial space, can predispose individuals to shoulder impingement syndromes, increasing their risk of rotator cuff tears. Although no significant differences were found in the effect of limb dominance on injury development, anatomical variations remain a relevant risk factor. Furthermore, biologic and genetic predispositions, including poor blood supply to the rotator cuff tendons, can impair healing and make certain individuals more vulnerable to tendon degeneration and injury, particularly as they age.(Xu et al., 2024)

Tab. 1
(Alkhabbaz et al., 2024; Baumann et al., 2024; Centeno et al., 2024; Chen et al., 2024; Daher et al., 2023; Fei et al., 2024; Gong et al., 2024; Kanat et al., 2024; Kang et al., 2024; Kim et al., 2024; Kjær et al., 2018; Kurtaliaj et al., 2024; Lafrance et al., 2024; Laprus et al., 2024; Lee et al., 2024; Li et al., 2024; A. Liu et al., 2024; L. Liu et al., 2024; Longo et al., 2012; Mohammadivahedi et al., 2024; Noh et al., 2024; Norris et al., 2024; Pitsilos et al., 2024; Ribeiro et al., 2020; Schneider et al., 2024; Seo et al., 2024; Shen et al., 2024; Somogyi Škoc et al., 2024; Sonone & Patil, 2024; Vilela et al., 2024; Xue et al., 2024; Yang et al., 2024; L. Zhang et al., 2024; Zhou et al., 2024; Zou et al., 2023)

TREATMENT METHOD	DESCRIPTION	EFFECTIVENESS	PROS	CONS
Biologic Augmentation	Uses biological materials (e.g., growth factors, stem cells, PRP) to promote healing.	Emerging as a promising alternative, especially in chronic or large tears.	Can enhance healing and tissue regeneration. Minimally invasive.	Limited long-term evidence. Expensive. Success rate may vary based on tear severity.

Stem Cell Therapy	Harvests and injects stem cells to stimulate tissue regeneration in the torn tendon.	Shows potential, especially for partial tears and early stages of injury.	Non-surgical. May improve healing time. Reduced inflammation and pain.	Still under research. Expensive. Not widely available.
Platelet-Rich Plasma (PRP)	Involves injecting a concentrated dose of platelets from the patient's blood into the injury site.	Moderate effectiveness, especially in partial-thickness tears.	Minimally invasive. Can promote faster healing by using the body's own resources.	Results can vary. Requires multiple sessions. Mixed evidence of effectiveness in full tears.
Arthroscopic Superior Capsular Reconstruction (SCR)	Repairs irreparable rotator cuff tears by using a graft to reconstruct the shoulder capsule.	High success rates, especially for massive tears.	Restores shoulder stability and strength. Minimally invasive. Good for large irreparable tears.	Long recovery time (6–12 months). Requires skilled surgeon. Risk of complications.
Subacromial Balloon Spacer	A balloon-like device inserted between the rotator cuff and acromion to reduce friction.	Effective for elderly patients or those with irreparable tears.	Minimally invasive. Immediate pain relief and improved shoulder movement.	Temporary solution (balloon may deflate or degrade). Short- to mid-term solution.
Intra-articular Hyaluronic Acid	Injects hyaluronic acid to lubricate the	Offers temporary pain relief, especially for early	Minimally invasive. Non-surgical.	Temporary relief. Does not treat the root

Injection	shoulder joint and reduce inflammation.	to moderate injuries.	Effective for short-term pain management.	cause. Requires repeated injections.
Ultrasound-Guided Percutaneous Needle Tenotomy (PNT)	Uses ultrasound to guide a needle to break down scar tissue and stimulate healing.	Effective for small- to medium-sized tears.	Minimally invasive. Quick recovery. No surgery required.	Less effective for large or full-thickness tears. Not suitable for all cases.
Tissue Engineering & Scaffold Implants	Uses scaffolds, sometimes combined with cells or growth factors, to aid tendon healing.	Promising in trials for improving tendon repair and healing.	Can improve tissue regeneration. Suitable for chronic or complex injuries.	Experimental. High cost. Not widely available.
Reverse Shoulder Arthroplasty (RSA)	A joint replacement procedure used in severe cases where rotator cuff repair isn't feasible.	High success rate for pain relief and restoring function.	Effective for massive tears or severe arthritis. Long-term solution.	Invasive surgery. Long recovery. Alters shoulder mechanics.
Electrotherapeutic Modalities (TENEX, Focused Shockwave Therapy)	Uses energy waves to break down scar tissue and promote healing.	Moderate success for chronic tendon injuries.	Minimally invasive. Shorter recovery period. Can target specific areas.	Limited effectiveness for larger or complete tears. Results may vary by patient.

Disclosure

Conclusions on New Treatment Methods for Rotator Cuff Injuries

Non-Surgical Treatments Are Becoming More Popular:

There is a trend toward using minimally invasive methods such as Platelet-Rich Plasma (PRP), Stem Cell Therapy, and Ultrasound-Guided Percutaneous Needle Tenotomy (PNT). These options are particularly beneficial for patients with partial tears or early-stage injuries. They offer faster recovery times and fewer risks compared to surgery, but the effectiveness can be variable, especially in more severe injuries. (Alkhabbaz et al., 2024; Centeno et al., 2024; Chen et al., 2024; Mohammadivahedi et al., 2024; Pitsilos et al., 2024; Schneider et al., 2024)

Biologic Therapies Hold Promise:

Biologic Augmentation using growth factors, PRP, and Stem Cell Therapy shows promise in promoting natural tissue healing and regeneration. While these methods are still in the experimental phase, early results are encouraging. However, they may not yet be reliable enough to replace surgical methods for severe or complete tears.(Shen et al., 2024)

Surgical Solutions Remain the Gold Standard for Severe Tears:

For massive or irreparable rotator cuff tears, surgical options such as Arthroscopic Superior Capsular Reconstruction (SCR) and Reverse Shoulder Arthroplasty (RSA) remain highly effective, providing long-term relief and restoration of function. These procedures, however, require skilled surgeons and involve longer recovery times.(Kjær et al., 2018)

Temporary Relief Methods Offer Non-Permanent Solutions:

Treatments such as the Subacromial Balloon Spacer and Intra-articular Hyaluronic Acid Injections offer short-term relief, especially for patients not fit for surgery or those seeking to delay surgery. However, these treatments are generally not curative and may need to be repeated or replaced with more definitive solutions as the injury progresses.

Tailored Treatment Plans Based on Injury Severity:

The choice of treatment should be personalized based on the patient's injury severity, age, activity level, and overall health. Minimally invasive treatments are preferred for milder cases, while severe injuries often still necessitate surgery. The growing use of biologics could become a viable option for a broader range of injuries as more research solidifies their effectiveness.

Cost and Availability Can Be Limiting Factors:

Emerging treatments like Stem Cell Therapy, Biologic Augmentation, and Scaffold Implants are expensive and not widely available. These high costs and

experimental nature may limit their accessibility to the general public, requiring patients to carefully weigh the potential benefits against financial constraints.

Final Thoughts

In summary, rotator cuff injury treatments are evolving rapidly, with new biologic and non-invasive options showing potential, especially for patients with less severe injuries. However, traditional surgical methods remain the most reliable for severe tears, with newer approaches providing valuable, albeit sometimes temporary, relief. Personalized treatment plans that balance the effectiveness, risks, and costs of these options will help achieve the best outcomes for patients.

Author's contribution

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The authors deny any conflict of interest.

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