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The Shoulder Surgery Update: Innovations and Insights

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Abstract

This comprehensive update on shoulder surgery highlights recent advancements in managing shoulder instability, rotator cuff tears, shoulder arthroplasty, and adhesive capsulitis. It highlights the evolution of surgical techniques, non-operative interventions, and biologic augmentation approaches. Innovations in rotator cuff repair include biologic solutions, such as platelet-rich plasma, while advancements in arthroplasty focus on tailored rehabilitation and infection control strategies. Adhesive capsulitis management now incorporates novel injection techniques and surgical options for refractory cases. This summary underscores the ongoing development of individualized treatment protocols, which are essential for optimizing patient outcomes and addressing the diverse challenges in shoulder surgery.

Keywords: Shoulder instability, rotator cuff, biologic augmentation, shoulder arthroplasty, adhesive capsulitis.

Introduction

The field of shoulder surgery has witnessed significant advancements, driven by a growing understanding of biomechanics and improved surgical techniques. This review examines recent progress in managing shoulder instability, rotator cuff injuries, shoulder arthroplasty, and adhesive capsulitis.

Emphasis is placed on emerging non-operative treatments, innovative surgical procedures, and biologic augmentation strategies, which collectively aim to enhance outcomes and expand treatment options. By addressing key developments in both surgical and non-operative care, this review highlights the importance of personalized treatment protocols that cater to the diverse challenges presented by shoulder pathology, ultimately aiming to improve patient function and satisfaction.

Shoulder Instability

Masud et al. [1] conducted a Bayesian network meta-analysis involving 52 studies to assess the rates of recurrent instability following either the Latarjet procedure or arthroscopic Bankart repair. Their analysis found that the Latarjet procedure was associated with a lower rate of recurrent instability overall. However, for the arthroscopic Bankart repair, the recurrence rate was higher when there was 10–20% glenoid bone loss, compared to cases with 0–10% bone loss. The presence of lesions, such as Hill-Sachs or osseous Bankart lesions, was associated with an increased risk of recurrent instability for both procedures.

Regarding return to sport, Hurley et al. [2] reviewed multiple studies and found wide variability in return-to-sport rates at pre-operative levels, with arthroscopic Bankart repair showing 61–94.1% and the Latarjet procedure showing 72–96.8%. There was no significant difference between the two procedures regarding return-to-sport rates or the time required to return to sport.

Systematic reviews on the Latarjet procedure by DeClercq et al. [3] examined radiographic outcomes over 12 months, finding high rates of arthritis (28%), graft osteolysis (30%), and other complications, such as non-union (5.1%) and bone-block fractures (2.1%). Although radiographs detected most issues, CT scans revealed higher osteolysis rates.

Comparing osseous augmentation techniques, Cozzolino et al. [4] analyzed recurrence, reoperation, and complication rates between arthroscopic Latarjet and free bone block procedures, finding similar rates between the two. However, complications were more common with screw fixation than flexible fixation. Another systematic review by

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Hali et al. [5] showed that suture button fixation had similar biomechanical and clinical outcomes as screw fixation, although screw fixation had higher graft resorption.

Jegatheesan et al. [6] reviewed outcomes for primary versus revision Latarjet procedures, finding no significant differences in complications, reoperations, or instability recurrence. However, patients who underwent a revision Latarjet procedure had a slightly higher infection rate compared to those undergoing a primary procedure.

Rotator Cuff

Non-Operative management

Non-operative management remains an essential approach for treating rotator cuff tears, with platelet-rich plasma (PRP) and corticosteroid injections as common interventions. A systematic review and meta-analysis of nine studies involving 537 patients found no significant differences in pain, function, complications, or retear rates between rotator cuff repair with PRP and without it [7]. Another meta-analysis of nine randomized controlled trials (RCTs) with 469 patients compared PRP and corticosteroids for rotator cuff disease, revealing that corticosteroids had better short-term outcomes, whereas PRP was more effective over the long-term based on measures, such as the Constant Murley score (CMS) and American Shoulder and Elbow Surgeons (ASES) score [8]. Another systematic review examined the effectiveness of PRP in treating partial-thickness rotator cuff tears. The meta-analysis of 12 randomized controlled trials with 762 patients found that PRP significantly improved pain scores (VAS) at short-term (6 weeks), mid-term (3 and 6 months), and long-term (1 year) follow-ups compared to control treatments. However, while PRP also showed statistically significant short-term improvements in functional scores (ASES and CMS), these benefits did not persist in the long term. The study noted considerable heterogeneity among trials, particularly regarding PRP formulations and control interventions, which complicates establishing definitive conclusions. Overall, PRP may effectively reduce pain for PTRCT patients, but its impact on sustained functional recovery remains uncertain [9].

Perioperative pain management has seen significant advances. Non-steroidal anti-inflammatory drugs (NSAIDs) and COX-2 inhibitors, long considered standard treatments, are being re-evaluated. A systematic review of seven RCTs (507 patients) found that NSAIDs did not affect healing but improved post-operative pain and function [10]. COX-2 inhibitors did not show differences in outcomes compared to NSAIDs. Another recent study focused on zoledronic acid in 138 post-menopausal women undergoing rotator cuff repair. While it reduced retear rates, it had no significant impact on clinical outcomes measured by ultrasound over 2 years [11]. In addition, the efficacy of braces versus slings after surgery was reviewed, and while no difference in pain or functional outcomes was found, the authors suggested a sling might be preferable for cost-effectiveness [12].

Surgical technique and biological augmentation

In surgical and biologic augmentation, enhancing the healing environment remains a priority. A recent RCT comparing arthroscopic repair with and without bone marrow stimulation in 60 patients showed no difference in retear rates or clinical outcomes after 2 years [13]. Similarly, a meta-analysis of five studies found no significant benefit from bone marrow stimulation on rotator cuff repair healing rates [14]. For partial subscapularis tears, a trial comparing repair and debridement over 5 years found no significant differences in pain, function, or range of motion [15].

Patch augmentation has shown promise, particularly for larger tears. A meta-analysis and systematic review by Orozco et al. [16] found that patch augmentation is linked to lower retear rates. In 193 patients across six studies, patch augmentation was beneficial. Another RCT involving 124 patients with posterosuperior tears evaluated a bioinductive collagen implant, which reduced retear rates at 1-year follow-ups [17]. In addition, a systematic review of RCTs suggested that acromioplasty might decrease the likelihood of reoperation [18].

For irreparable rotator cuff tears, tendon transfers and grafts offer valuable options. A systematic review of lower trapezius transfer in seven studies with 159 patients reported improved clinical outcomes, with complication and reoperation rates comparable to other methods [19]. Another review focusing on latissimus dorsi tendon transfer across 11 studies with 421 patients indicated substantial improvements in patient-reported outcome measures, pain, range of motion, and strength over the intermediate to long term (4–9 years and beyond) [20].

Alternative treatments are also emerging. A mini-open fascia lata interposition graft was compared to arthroscopic partial repair in an RCT, which found superior University of California Los Angeles (UCLA) shoulder scores and rotational improvements with the interposition graft over 2 years [21]. Subacromial balloon spacers are another option; a meta-analysis of 17 studies with 894 shoulders demonstrated that spacers are generally safe and effective for short-term relief, though heterogeneity and limited control of patient selection indicate a need for further research [22].

Overall, while non-operative options and biologic

augmentation provide alternatives for rotator cuff tears, the treatment of irreparable tears continues to evolve with promising yet varied approaches, such as tendon transfers, grafts, and spacers, highlighting the need for ongoing comparison to establish optimal management strategies.

Shoulder Arthroplasty

Recent studies have examined various aspects of shoulder arthroplasty, particularly focusing on rehabilitation and surgical techniques. In a randomized controlled trial (RCT), Khalil et al. [23] found no improvement in outcomes with a subscapularis-specific rehabilitation program after anatomic total shoulder arthroplasty (TSA). In contrast, Schick et al. [24] reported that patients undergoing reverse TSA who participated in formal outpatient therapy achieved better external rotation strength compared to those on a home exercise program, although other outcome measures were similar.

Regarding surgical techniques, Bethell et al. [25] performed a meta-analysis that showed subscapularis repair during reverse TSA reduced instability rates when a medialized implant was used, but not with a lateralized design. Southam et al. [26] investigated the impact of lateralization in reverse TSA, finding no differences in outcomes such as range of motion, scapular notching, or strength over a 2-year follow-up. In addition, a study on 3D-printed glenoid guides demonstrated that in-house printed guides enhanced the correction of glenoid version without affecting inclination accuracy [27].

The timing of reverse TSA after fractures also influences outcomes. A meta-analysis by Lu et al. [28] indicated that acute TSA after fracture led to better outcomes in terms of range of motion and complication rates compared to the delayed TSA after conservative management or previous fixation.

Managing complications such as periprosthetic joint infections remains critical. Wright et al. [29] found that hydrogen peroxide application during surgery slightly reduced the positivity rate of Cutibacterium acnes cultures. Further, a meta-analysis by Rodrigues-Lopes et al. [30] suggested that one-stage revision for infection in shoulder arthroplasty was associated with lower complication and reinfection rates compared to two-stage revision.

These findings highlight the importance of tailored rehabilitation, strategic surgical planning, and infection control in optimizing shoulder arthroplasty outcomes.

Adhesive Capsulitis

Frozen shoulder, or adhesive capsulitis, is characterized by painful glenohumeral capsule contracture. Intra-articular corticosteroid injections are commonly used in treatment, though techniques and doses vary. A systematic review analyzed high-dose versus low-dose corticosteroid injections and found no significant differences in pain relief, range of motion, or functional improvement at intervals up to a year. Consequently, the authors favored low-dose injections to minimize side effects. Injection location and technique also influence outcomes [31]. An RCT comparing single-site rotator interval injections to multiple-site injections found both methods improved pain and function, but multisite injections showed better pain relief and range of motion at 4 and 8 weeks [32].

Hydro dilatation is another approach, involving larger saline volumes than typical corticosteroid injections. A study comparing two different hydro dilatation volumes showed superior flexion and external rotation with higher volume injections at 12 weeks [33]. In addition, hydro dilatation combined with physical therapy showed better outcomes in pain relief and range of motion compared to physical therapy alone [34].

PRP injections are also explored in adhesive capsulitis. A meta-analysis of 14 studies found PRP injections significantly improved pain, disability, and range of motion at 3 months, with sustained pain relief and functional improvement at 6 months, without adverse reactions [35].

When injections and physical therapy are ineffective, surgical release may be considered. A study on percutaneous coracohumeral ligament release (PCHLR) with a Tenex needle showed that patients had substantial improvements in external rotation, abduction, and the Oxford Shoulder Score at 1-year follow-up compared to those who received local anesthetic alone [36]. These findings support the benefit of targeted injections and, in refractory cases, surgical interventions to enhance recovery in adhesive capsulitis.

Conclusion

Shoulder surgery continues to advance through innovations in both non-operative and operative techniques. The Latarjet procedure remains a robust option for shoulder instability, particularly with significant glenoid bone loss. For rotator cuff injuries, biologic augmentations and novel surgical methods, such as tendon transfers and spacers, provide promising outcomes for irreparable tears. Shoulder arthroplasty techniques, along with enhanced infection management, are improving patient recovery and satisfaction. Adhesive capsulitis treatments now incorporate diverse options, such as PRP, hydro dilatation, and surgical release. These evolving strategies emphasize personalized, evidence-based approaches to optimize outcomes across various shoulder pathologies.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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