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Rehabilitation After Anatomic and Reverse Total Shoulder Arthroplasty

A Critical Analysis Review

Jacob M. Kirsch, MD

Surena Namdari, MD, MSc

Investigation performed at the Departments of Orthopaedic Surgery and Shoulder and Elbow Surgery, The Rothman Institute-Thomas Jefferson University, Philadelphia, Pennsylvania

Abstract

» Postoperative rehabilitation is believed to be essential in optimizing clinical outcome and function following shoulder arthroplasty. Despite this long-held notion, there is a paucity of high-quality evidence to guide rehabilitation protocols and practice.

» For patients undergoing anatomic total shoulder arthroplasty (ATSA), there are insufficient comparative data regarding type or duration of sling utilization.

» Based on current evidence, there is no appreciable benefit to early motion compared with a delayed-motion protocol following ATSA.

» There is insufficient literature to support the use of formal physical therapy over a physician-directed program following ATSA.

» At the present time, no high-quality evidence exists to guide the postoperative rehabilitation of patients undergoing reverse total shoulder arthroplasty (RTSA).

» Prospective randomized controlled trials evaluating postoperative management and rehabilitation following ATSA and RTSA are needed to guide best practices and optimize clinical outcomes.

Anatomic total shoulder arthroplasty (ATSA)[1-7] and reverse total shoulder arthroplasty (RTSA)[7-13] can result in long-term pain relief and improved clinical function. The overall rate of shoulder arthroplasty being performed in the United States has increased dramatically over the last decade and is projected to continue in this trend[14-16]. While there are numerous factors that contribute to successful results following shoulder arthroplasty, adherence to a postoperative rehabilitation protocol is believed to be intimately correlated with patient outcomes[17-23]. The main tenet of shoulder rehabilitation involves early joint protection with progressive functional mobilization and strengthening.

The value of postoperative therapy and rehabilitation following shoulder arthroplasty must be considered in light of the outcomes relative to time investment and cost. Particularly in the current health-care climate, optimal health-care resource utilization is paramount. Recent studies have attempted to better understand

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cost utilization following shoulder arthroplasty[24,25]. While many of the factors that influence cost after shoulder arthroplasty are nonmodifiable[24], home health care represents approximately 70% of postoperative cost utilization[25].

There is currently a lack of consensus among the numerous protocols that exist for rehabilitation following shoulder arthroplasty. Recent attempts to systematically evaluate the current literature have highlighted a paucity of high-quality evidence guiding rehabilitation practices[26-29]; the vast majority of the published literature consists of Level-V evidence[18,21-23,26,28,30-32]. The purpose of this review article is to provide an evidence-based analysis of the literature (excluding Level-V evidence) supporting various aspects of the rehabilitation process following shoulder arthroplasty and to highlight areas where additional research is necessary.

ATSA

A critical factor influencing the outcome of ATSA is successful subscapularis management and postoperative function. Appropriate releases and mobilization of the subscapularis are not only necessary for adequate glenoid exposure but critical for addressing internal rotation contractures and restoring the normal horizontal force couple of the shoulder[33,34]. Subscapularis insufficiency following ATSA is a major complication, which results in altered glenohumeral kinematics[35,36], pain, instability, and poor function[33,37-40]. Even in the absence of obvious clinical deficiency, chronic denervation and reinnervation have been demonstrated in 30% of patients undergoing ATSA[41]. Therefore, much of the focus regarding rehabilitation has been directed to the balance between subscapularis protection and shoulder mobilization.

Sling Utilization

Little to no consensus exists on the type and duration of sling use following ATSA. Most clinical studies mention the use of some form of immobilization following ATSA[5,41-52]. Recently, Tirefort et al.[53] performed a randomized trial comparing patients with and without use of a sling postoperatively following rotator cuff repair; however, to our knowledge, no comparative study exists on patients following shoulder arthroplasty. The most commonly reported forms of immobilization following ATSA are a simple sling[41,45,46,48,49], a shoulder immobilizer[43,44,50,51], or an abduction sling[5,42]; however, to our knowledge, no comparative data exist. The duration of immobilization also is variable, ranging from <24 hours[41,44,46] to 6 weeks postoperatively[5,42,43,45,48-51], again without any comparative studies in the literature.

Despite the limited evidence on sling utilization, Baumgarten et al. provided some insight pertaining to the influence of arm position during sling immobilization following ATSA[48]. They performed a Level-II randomized controlled trial comparing 36 patients who were randomized to either a neutral rotation sling or an internal rotation sling for 6 weeks after ATSA with a subscapularis tenotomy. Various functional and patient-reported outcomes were assessed, along with range of motion at various postoperative time points. No significant functional or patient-reported outcome differences were found between the groups. The neutral rotation group, when compared with the internal rotation group, demonstrated greater improvement in range of motion over time, with significant differences in active and passive external rotation with the arm in neutral (42° versus 25°, $p = 0.03$; 44° versus 26°, $p = 0.05$, respectively) as well as passive horizontal adduction ($p = 0.05$)[48]. The patients who used the neutral rotation sling also had significantly less night pain at 2 weeks ($p = 0.047$); however, no long-term differences in pain were noted.

While activities are typically restricted immediately after ATSA, there is insufficient comparative data to recommend a specific type or duration of shoulder immobilization. Based on the single Level-II study, a neutral rotation sling may have some benefit over an internal rotation sling.

Range of Motion

Another important aspect of rehabilitation following ATSA pertains to when motion should be initiated and whether any restrictions to motion should be considered. Early passive motion of the shoulder has traditionally been advocated to avoid stiffness since postoperative stiffness remains one of the most common issues in patients who are unsatisfied following shoulder arthroplasty[54,55]. Recent literature describing rotator cuff repair demonstrates mixed results regarding early-motion protocols compared with delayed-motion protocols, with no clear consensus[56-61]. Clinical studies have almost uniformly reported a protocol that involves early passive shoulder motion following ATSA[5,33,41-50,62,63]. However, despite the overwhelming reporting of early-motion protocols, no comparative data exist to support the specific parameters or limitations to motion in the described protocols.

To our knowledge, there are only 2 clinical trials that have evaluated the role of early compared with delayed passive shoulder motion following ATSA[51,52] (Table I). Most recently, Denard and Lädermann performed a Level-I randomized controlled trial comparing immediate and delayed passive motion in 55 patients undergoing ATSA with a lesser tuberosity osteotomy (LTO)[52]. Patients in the immediate-motion group used a sling for 4 weeks postoperatively and were allowed to start unlimited passive forward flexion and passive external rotation to 30° following surgery. Sling immobilization ended at 4 weeks, and patients were allowed to progress their passive external rotation without restriction and initiate active and active-assisted forward flexion. Patients in the delayed-motion group used a sling for immobilization for 4 weeks without being allowed any passive shoulder motion. Similarly, sling immobilization ended at 4 weeks, and

TABLE I Early Versus Delayed Motion After ATSA*

Study (Year)	Level of Evidence	Subscapularis Management	Immediate-Motion Protocol	Delayed-Motion Protocol	Outcomes
Denard and Lädermann[52] (2016)	I: randomized controlled trial	LTO	Sling: worn for 4 weeks. Motion: starting on POD #1, passive forward flexion as tolerated and passive external rotation to 30°; at 4 weeks, passive forward flexion was gradually progressed to active motion as tolerated and to passive external rotation as tolerated. Strengthening: initiated at 8 weeks. Activities as tolerated: starting at 12 weeks	Sling: worn for 4 weeks. Motion: no shoulder motion during first 4 weeks; at 4 weeks, passive forward flexion and external rotation as tolerated; at 8 weeks, gradually progress to active forward flexion and external rotation as tolerated. Strengthening: initiated at 8 weeks; initiated at 16 weeks	No significant difference in ROM, VAS, ASES, or SANE score at 1 year postoperatively. LTO healing: immediate motion (22/27, 81.5%); delayed motion (27/28; 96.4%). No significant difference between LTO healing and motion protocol (p = 0.101). Patients with healed LTOs had significantly better ASES scores (p = 0.008)
Mulieri et al.[51] (2010)	III: case-control study	Subscapularis tenotomy	Shoulder immobilizer: worn for 6 weeks. Motion: starting at POD #1 for 3 weeks, supine passive scaption to a maximum of 120° and external rotation to 20°; at weeks 4-6, progress to supine active-assisted range of motion; at weeks 7-9, progress to supine and prone active range of motion; after 9 weeks, standing active range of motion and activities of daily living. Strengthening: initiated at 9 weeks. Activities as tolerated: starting at 9 weeks	Shoulder immobilizer: worn for 6-8 weeks. Motion: only pendulum exercises allowed for the first 6-8 weeks; after 6-8 weeks, supine active-assisted forward flexion and activities of daily living; after 14 weeks, allowed to participate in activities as tolerated. Strengthening: no formal strengthening. Activities as tolerated: after 14 weeks	Note: The immediate-motion group received formal physical therapy, whereas the delayed-motion group received a physician-directed therapy protocol. No difference in ASES or SST score at any time point. The delayed-motion group had significantly better forward flexion (154° vs. 119°; p = 0.024) and abduction (147° vs. 108°; p = 0.03) at the time of the final follow-up

*ATSA = anatomic total shoulder arthroplasty, LTO = lesser tuberosity osteotomy, POD = postoperative day, ROM = range of motion, VAS = visual analog scale, ASES = American Shoulder and Elbow Surgeons, SST = Simple Shoulder Test, and SANE = Single Assessment Numeric Evaluation.

patients then were allowed unrestricted passive forward elevation and external rotation. At 8 weeks, patients were allowed to begin unrestricted active and active-assisted motion. Both groups began strengthening exercises at 8 weeks postoperatively. While the immediate-motion group demonstrated better visual analog scale (VAS) pain, American Shoulder and Elbow Surgeons (ASES), and Single Assessment Numeric Evaluation (SANE) scores initially, no differences existed from 3 months onward. Additionally, there were no significant differences in range of motion at 1 year. Of note, the authors evaluated LTO healing and found that 22 (81%) of 27 patients healed in the immediate-motion group compared with 27 (96%) of 28 patients in the delayed-motion group; however, this difference was not significant ($p = 0.101$). Furthermore, improved functional outcome scores were evident when the LTO had healed. These results suggested little clinical and functional downside to delaying passive motion, with the possible benefit of improved LTO healing when compared with an immediate-motion protocol.

Mulieri et al. also evaluated the concept of immediate versus delayed motion following ATSA[51]. They performed a retrospective Level-III analysis of 81 patients undergoing ATSA with a subscapularis tenotomy. Patients either began immediate passive range of motion and formal physical therapy or had 6 weeks of immobilization with only pendulum exercises with a subsequent physician-directed home exercise program. At the time of final follow-up, compared with the immediate-motion group, the delayed-motion group had better forward flexion (154° versus 119°, p = 0.024) and better abduction (147° versus 108°, p = 0.03). Of note, there was no evaluation of external rotation or assessment of tendon healing in the study.

In addition to the concept of early or delayed passive motion, the range of motion allowed by surgeons following ATSA varies considerably and lacks consensus. To our knowledge, to date, there have been no comparative studies evaluating specific restrictions in this regard. Most studies report restricted passive external rotation to 30° to 40° for a certain period postoperatively[33,41,42,46,49,52,63], whereas other authors restricted passive external rotation to neutral[5,43,45,47,62]. Additionally, some studies have reported initial passive forward flexion only to approximately 90°[5,43,45,47,62], whereas others encouraged more liberal forward flexion to 130° or more[33,41,42,46,63]. Biomechanical data suggest that having restrictions to external rotation and abduction following shoulder arthroplasty may be beneficial for decreasing the strain on the repaired subscapularis[20,64].

Despite the popular notion of early passive motion following shoulder arthroplasty, the 2 studies with Level-I and Level-III evidence that directly evaluated this concept demonstrated no appreciable benefit to early motion compared with a delayed protocol. Limited evidence suggests that early motion may adversely influence healing rates after LTO. Additional research dedicated to elucidating the potential effects of early motion on subscapularis repair integrity and functional outcome following shoulder arthroplasty is necessary. There is currently insufficient evidence to recommend restrictions to passive or active motion in the early period following shoulder arthroplasty.

Strengthening

Maintaining reestablished muscular balance through periscapular and rotator cuff strengthening is believed to be an important component of postoperative rehabilitation following ATSA. Scapulothoracic motion contributes more to overall shoulder motion after ATSA when compared with healthy shoulders[65]. Therefore, strengthening of periscapular musculature, including the lower trapezius and the serratus anterior with retraction and protraction exercises, is beneficial to promote neuromuscular scapular control while minimizing stress across the glenohumeral joint. Gradual strengthening of the rotator cuff is necessary for dynamic shoulder balance and for the longevity of the prosthesis; however, this is often delayed, allowing for healing of the subscapularis. Baumgarten et al. reported that improvement in shoulder strength following ATSA was associated with improved shoulder activity level and SANE scores[49]. However, to our knowledge, there are no comparative studies, and only with limited clinical evidence overall to guide the timing and nature of strengthening protocols following ATSA.

Physical Therapy After ATSA

The vast majority of patients participate in either physician-directed home therapy or formal therapist-directed physical rehabilitation following ATSA. Based on an insurance claims database, Wagner et al. recently highlighted the substantial variability in the utilization of formal therapy following shoulder arthroplasty[66]. Moreover, to our knowledge, there are no clinical trials that have compared physical therapy or strengthening protocols following ATSA, and most of the reported literature provides insufficient data regarding the specific therapy protocols to draw any meaningful conclusions.

Limited evidence supports the use of a home-based therapy program following ATSA[19,51]. Boardman et al. challenged the notion of mandatory formal therapy and strengthening following ATSA[19]. They reported on 81 patients undergoing ATSA followed by a home-based therapy program consisting of passive shoulder motion for 5 weeks, after which progressive active motion and light isometric strengthening exercises were performed[19]. While only 80% of patients had a satisfactory outcome, it is hard to know whether some of those patients would have been better managed with an RTSA, which was not available during that time. As mentioned above, Mulieri et al. performed a Level-III retrospective study evaluating patients undergoing ATSA with 2 different postoperative protocols[51]. Of note, the senior author changed his postoperative protocol to one that was surgeon-directed out of concern for overly aggressive formal therapy. The patients in the home therapy group used a shoulder immobilizer for 6 to 8 weeks, and only pendulum exercises were allowed during that time. Immobilization was discontinued after 6 to 8 weeks, and the patients started doing supine active-assisted forward flexion. By 14 weeks, they were allowed to participate in unrestricted activities. Compared with the formal therapy group, patients in the home-based therapy group had better forward flexion (154° versus 119°, p = 0.024) and better abduction (147° versus 108°, p = 0.03)[51].

Based on the available evidence, there is no literature to support the use of formal physical therapy over a physician-directed program. Prospective evaluation of the functional and economic differences for different types of postoperative therapy following ATSA is particularly pertinent in the current health-care climate. Additionally, there is no consensus in the literature regarding the timing and nature of strengthening following ATSA.

RTSA

RTSA has unique biomechanics and is indicated for a wider breadth of shoulder pathology compared with ATSA. Therefore, rehabilitation of patients undergoing RTSA must be considered as a separate entity. To date, there is little to no consensus regarding the postoperative management of patients undergoing RTSA because of the lack of any prospective comparative literature evaluating rehabilitation protocols. In the following sections, we attempt to provide an evidence-based evaluation of rehabilitation protocols after RTSA and highlight knowledge gaps.

Sling Utilization

Little to no consensus exists regarding sling utilization following RTSA. Similar to ATSA, while initial immobilization is nearly universally reported, there are substantial discrepancies regarding the type and duration of immobilization. As with ATSA, the most commonly used designs are the simple sling[67-72], the shoulder immobilizer[12,73,74], and the abduction sling[75-79]. Currently, to our knowledge, no comparative studies exist evaluating the type of immobilization following RTSA. However, unlike ATSA, the overwhelming majority of clinical literature reports 4 to 6 weeks of immobilization following RTSA[12,67,69-71,73,74,76-80]. We found no comparative studies evaluating the duration of immobilization following RTSA.

Early instability is a more substantial concern after RTSA than after ATSA[81-83]. Cheung et al. reported a 9.2% rate of early instability following RTSA. Of those patients, 45% remained unstable following initial reduction, and they ultimately required a revision operation[81]. The authors identified several risk factors, including male sex, prior open surgery, fracture sequelae, and an irreparable subscapularis. Of note, following the initial surgery, an abduction sling was used for immobilization for 6 weeks, and the mean time to instability was 8 weeks. Chalmers et al. reported early instability in 2.9% of their patients, which occurred at a mean of 3.4 weeks postoperatively[82]. Postoperative immobilization with a simple sling was used initially with all of the patients, and only pendulum exercises were permitted until 4 weeks. Similar to the study by Cheung et al.[81], male sex, previous surgery, and an irreparable subscapularis were associated with instability following RTSA. Kohan et al. reported on a cohort of patients who dislocated within 3 months of RTSA[83]. Of these patients, 50% dislocated within the first 2 weeks. Immobilization with a simple sling for 2 to 3 weeks postoperatively was used initially with all of the patients, and they were restricted from internal rotation for 6 weeks.

While the literature lacks conclusive evidence regarding the type and duration of immobilization, it does not appear that early immobilization eliminates early instability[81]. Because many instability events are atraumatic in nature, it is unclear whether immobilization reduces the risk of dislocation. Prospective evaluation directly comparing early immobilization with early mobilization is necessary to understand whether there is an effect on early instability and ultimate functional outcomes after RTSA.

Range of Motion

There is no consensus regarding the initiation and progression of passive or active motion following RTSA. There are several factors that influence when shoulder motion should be started, including subscapularis protection (if a repair was performed), the risk of early instability, and the concern for early acromial stress[71,81,82,84]. There is substantial disagreement in the literature between reports of immediate passive range of motion[12,69,71,75-77,80] and delayed passive range of motion[67,70,73,74,78,85-87]. The majority of studies report delaying the initiation of passive motion for up to 1 week postoperatively[67,70,72,74,78,85]; however, other authors have reported waiting longer to initiate passive motion[73,87]. Differences also exist in the literature when it comes to initiating active range of motion. Most studies indicate waiting at least 4 weeks to start active motion[12,67,69,70,73,74,76,78,80,85]. The use of continuous passive motion protocols also has been reported; however, the evidence is very limited[78]. To our knowledge, no prospective comparative study currently exists evaluating range-of-motion protocols following RTSA. Given the variability in the literature and the lack of prospective comparative studies, there is insufficient evidence to recommend for or against specific range-of-motion protocols following RTSA.

Strengthening

RTSA alters shoulder biomechanics and relies more heavily on deltoid and periscapular muscle function than ATSA[88]. Several authors have evaluated the effect of RTSA on glenohumeral kinematics, which provides some insight pertaining to optimizing rehabilitation[65,89-93]. Following RTSA, there is altered scapulohumeral rhythm compared with the native shoulder, with decreased glenohumeral elevation and more reliance on the deltoid, the scapula, and the trapezius for shoulder abduction[65,89,90,92,93]. Wiater et al. highlighted the importance of deltoid function by reporting that patients with larger deltoid size and less fatty infiltration had greater functional outcomes and strength following RTSA[94]. Electromyographic analysis also has demonstrated that shoulders with a reverse prosthesis have greater muscle activation in the deltoid and the trapezius compared with normal shoulders[90]. Matsuki et al. found that no changes in shoulder kinematics occurred after 6 months following RTSA[91], which interestingly correlates with when these patients appear to plateau clinically[7].

Deltoid and periscapular function are critical following RTSA. Based on the available evidence, patients may benefit from scapulothoracic and deltoid rehabilitation after RTSA; however, the extent to which this should be performed cannot be concluded. Most studies indicate waiting until at least 8 weeks postoperatively to start a strengthening program[70,73,74,76,87]; however, due to the lack of comparative data, it is unclear if there is an optimal time to start strengthening.

Special Scenarios

Concomitant Tendon Transfer

Depending on rotator cuff status, external rotation may not be reliably restored following RTSA[95]. Concomitant tendon transfer at the time of RTSA can help restore external rotation, particularly in abduction. There is limited evidence guiding the rehabilitation of these patients, which is based largely on case series. Boileau et al. reported on patients undergoing RTSA with a combined latissimus dorsi and teres major transfer[96,97]. Postoperatively, the arm was immobilized in 30° of abduction and 30° of external rotation for 6 weeks before allowing any shoulder motion. Patients began passive elevation and rotation with a therapist at 6 weeks. Internal rotation was limited for 12 weeks, and therapy lasting anywhere from 6 to 12 months was advocated. A similar protocol was reported by Boughebri et al. following RTSA with combined latissimus dorsi and teres major transfer[98]. Shi et al. also reported on a similar procedure; however, their patients used a neutral rotation brace for 6 weeks postoperatively with no active shoulder motion during that time[99]. At 4 weeks, physical therapy was started, but passive external rotation was limited to 30° to 40° and internal rotation was delayed until 6 weeks. The authors also commented on the use of biofeedback during rehabilitation, starting at 10 to 12 weeks[99].

Other studies have reported on isolated latissimus dorsi tendon transfer during RTSA[100,101]. Gerber et al. had their patients use a brace for immobilization in 20° of abduction and neutral rotation for 2 to 10 days following surgery and then transitioned them to a sling[100]. Passive forward elevation was started as early as postoperative day 2, with active-assisted motion starting at 6 weeks and strengthening starting at 3 months. Conversely, Ortmaier et al. had patients use a sling for immobilization for 6 weeks postoperatively, after which active range of motion was begun[101]. Patients in this series were allowed to begin activity as tolerated as early as 12 weeks postoperatively.

Revision Surgery

RTSA may be a more reliable option for failed or revision shoulder arthroplasty in certain patients. However, studies evaluating RTSA in the setting of revision surgery have noted higher rates of complications, including reoperation and instability[102-106]. As a result, most studies have reported 4 to 6 weeks of shoulder immobilization with limited early motion[12,107-111]. While pendulum exercises often were the only permitted shoulder motion postoperatively, active motion regularly was delayed until 6 weeks[12,107,108,111]. Given the higher rate of complications associated with revision surgery, a nonoperative approach for postoperative rehabilitation may be warranted; however, there is currently little evidence to guide recommendations.

Proximal Humeral Fracture

RTSA represents an attractive option for older lower-demand patients with proximal humeral fractures. A unique advantage of RTSA for fracture is that tuberosity healing is not required for good function, although better outcomes have been reported when the tuberosities heal[112,113]. To date, to our knowledge, there are no comparative studies evaluating postoperative immobilization or rehabilitation following RTSA for proximal humeral fractures. Immobilization with an abduction sling has biomechanically been shown to reduce rotator cuff tension[114]; however, the clinical impact following RTSA for fracture remains uncertain. Klein et al. had patients use an abduction sling for immobilization for 4 weeks postoperatively following RTSA for fracture[78]. Patients were limited to 90° of passive flexion and abduction, without any internal or external rotation limitation, for 2 weeks, and they had no motion restriction after 4 weeks. Chalmers et al. reported a nonoperative approach where immobilization was used for 4 weeks without pendulum exercises or passive shoulder motion[82]. Boileau et al. had patients use a neutral rotation sling for immobilization for 4 weeks while participating in a self-directed passive range-of-motion program starting immediately postoperatively[13]. After 4 weeks, the sling was discontinued and formal therapy was started, with return to full activities by 3 to 6 months. Other variations of postoperative protocols have been reported[70,115,116]; however, the lack of consensus regarding

TABLE II Grades of Recommendation for Rehabilitation After Shoulder Arthroplasty

Intervention	Grade* ATSA	Grade* RTSA
Sling utilization		
Use of sling	B	B
Type of sling	I	I
Duration of sling wear	I	C
Motion		
Early-motion protocol	B	I
Delayed-motion protocol	B	I
Motion restrictions	I	I
Formal postoperative therapy/strengthening	I	I
Home-based postoperative therapy/strengthening	C	I

*ATSA = anatomic total shoulder arthroplasty, and RTSA = reverse total shoulder arthroplasty. Grade A: good evidence (Level-I studies with consistent findings) for or against recommending intervention. Grade B: fair evidence (Level-II or III studies with consistent findings) for or against recommending intervention. Grade C: conflicting or poor-quality evidence (Level-IV or V studies) not allowing a recommendation for or against intervention. Grade I: there is insufficient evidence to make a recommendation.

postoperative rehabilitation precludes evidence-based recommendations.

Weight-Bearing Upper Extremity

Wheelchair-reliant patients often depend heavily on the use of their upper extremities for mobility and transfers. Not surprisingly, these patients can have high rates of shoulder pathology[117]. Performing RTSA in these patients requires a substantial amount of consideration. There is currently limited evidence to guide the rehabilitation of wheelchair-reliant patients following RTSA[118,119]. Kemp et al.[118] and Alentorn-Geli et al.[119] used sling immobilization with wheelchair-reliant patients for 6 weeks following RTSA, while allowing limited passive range of motion. Both studies discontinued sling immobilization and started active and active-assisted range of motion at 6 weeks, and allowed patients to use their arm for transfers at 3 to 4 months. Kemp et al. reported 2 dislocations at approximately 3 months postoperatively, which coincided with the time period for starting to use the arm for weight-bearing. No complications were reported by Alentorn-Geli et al., and all of the patients reported that they would undergo RTSA again.

Overview

ATSA and RTSA can reliably provide pain relief and restore function for individuals with a variety of shoulder conditions. While there has been a dramatic increase in the rate of these procedures being performed and in the amount of published literature on various outcomes, there is a remarkable lack of clinical evidence guiding the rehabilitation of these patients. Prospective randomized controlled trials evaluating postoperative management and rehabilitation following ATSA and RTSA are needed to guide best practices and optimize clinical outcomes. Summarizing recommendations for the rehabilitation of patients undergoing ATSA and RTSA (Table II) are currently limited secondary to the paucity of high-quality evidence. Additional prospective trials evaluating various components of the rehabilitation process are needed to maximize patient outcome and optimize resource utilization.

Jacob M. Kirsch, MD[1],
Surena Namdari, MD, MSc[1]

[1]Departments of Orthopaedic Surgery and Shoulder and Elbow Surgery, The Rothman Institute-Thomas Jefferson University, Philadelphia, Pennsylvania

Email address for S. Namdari:
Surena.Namdari@rothmaninstitute.com

ORCID iD for J.M. Kirsch:
0000-0002-1368-3512
ORCID iD for S. Namdari:
0000-0002-8222-554X

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