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Chronic glenohumeral dislocations treated with arthroplasty: a systematic review

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Background: The aim of this systematic review was to summarize the clinical outcomes and associated predictors of outcomes for chronic glenohumeral dislocations treated with arthroplasty.
Methods: A systematic literature search was performed with Embase, PubMed, CENTRAL, BIOSIS, and CINAHL databases from the inception of these databases through January 1, 2021 to identify all articles that examined outcomes or predictors of outcomes of arthroplasty in patients with chronic glenohumeral dislocations. Studies that examined outcomes for patients with a chronic glenohumeral dislocation (≥3 weeks) treated with hemiarthroplasty, anatomic total shoulder arthroplasty, or reverse total shoulder arthroplasty were included. Those with acute or subacute dislocations (<3 weeks), fracture dislocations, and those treated with joint preserving treatment modalities were excluded.
Results: We identified 195 articles; of which, 22 (201 patients/205 shoulders) met our inclusion criteria. A total of 14 studies reported outcomes of hemiarthroplasty, 10 studies reported outcomes of anatomic total shoulder arthroplasty, and 9 studies reported outcomes of reverse total shoulder arthroplasty. All studies documented clinical improvement after arthroplasty. Among 16 studies that measured range of motion, all 16 studies demonstrated improvement in range of motion postoperatively. Thirty-one reoperations (15%) were performed across all studies.
Conclusion: We found improved clinical outcomes after arthroplasty for the treatment of chronic glenohumeral fewer dislocations at a long-term follow-up. Some evidence suggests that reverse total shoulder arthroplasty may have superior outcomes and less complications compared with hemiarthroplasty and anatomic total shoulder arthroplasty. There is insufficient evidence regarding the potential influence that duration of dislocation, direction of dislocation, addition of concomitant procedures, or humeral component retroversion have on outcomes.

Chronic glenohumeral dislocations are rare injuries that represent less than 2% of all shoulder dislocations.[3] Although the exact definition is debated, many authors agree that a chronic glenohumeral dislocation (GHD) is defined as a delay in diagnosis by at least 3 weeks.[1,6,14,18,24] However, the exact definition is debated in the literature.[18,19] A combination of factors including poor patient communication, incomplete examination, and/or inadequate radiographic evaluation may contribute to the delay in diagnosis.[2] The presence of humeral head and glenoid bone defects as well as soft-tissue contractures make the treatment of these injuries challenging. Associated articular cartilage deterioration, poor bone quality, and compromised soft tissues often make arthroplasty the preferred treatment over joint preserving operations.[24]

Some of the common indications for arthroplasty in the setting of chronic glenohumeral dislocations include elderly patients, humeral head defects greater than 40% of the articular surface. Significant glenoid bone loss, presence of irreparable rotator cuff tears, and dislocations greater than 6 months in duration.[7,19,26] Hemiarthroplasty (HA) and anatomic total shoulder arthroplasty (ATSA) were the first types of arthroplasty used to treat chronic glenohumeral dislocations. However, the introduction of reverse total shoulder arthroplasty (RTSA) has received significant emphasis in recent years owing to its semiconstrained design and successful outcomes in patients with irreparable rotator cuff tears.[17]

Although no large cohorts are available in the literature, several small case series report their outcomes for HA, ATSA, and/or RTSA in the setting of chronic glenohumeral dislocation.[3,5–15,18,20–26]

Institutional review board approval was not required for this review.

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2666-6391/

Compiling the results of these studies can provide surgeons with a single source of streamlined information and help to identify factors that affect outcomes. The aim of this systematic review was to summarize the literature that has examined clinical outcomes and predictors of clinical outcomes for chronic glenohumeral dislocations treated with arthroplasty. We hypothesized that clinical outcomes would improve and that patients that underwent RTSA would have superior outcomes compared with HA and ATSA.

Materials and methods

Search strategy

A systematic review of the literature was performed with Embase, PubMed, CENTRAL, BIOSIS, and CINAHL databases from inception of these databases through January 1, 2021 to identify all articles that examined outcomes of chronic glenohumeral dislocations treated with arthroplasty. Search terms included (arthroplasty OR replacement) AND chronic AND (glenohumeral OR shoulder) AND dislocation. In addition, the reference lists of articles meeting inclusion criteria were manually reviewed to search for further applicable studies. The literature search was performed separately by 2 independent reviewers and the results were compared. A flow diagram of the literature search was created in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.

Selection of studies

We included studies of patients treated with HA, ATSA, or RTSA for chronic glenohumeral dislocations, defined as 3 weeks or greater in duration. Only studies that reported postoperative outcomes were included. We excluded studies with acute dislocations defined as less than 3 weeks in duration, periprosthetic dislocations, and concomitant fractures other than bony Bankart and humeral head impression fractures. We also excluded studies of patients treated with joint preservation operations and those not published in English.

Data extraction

The following data were extracted from each article: study design, level of evidence, age, sex, duration of dislocation, mechanism of injury, duration of postoperative follow-up, direction of dislocation (anterior or posterior), percentage of humeral head defect, procedure performed (HA, ATSA, or RTSA), humeral component retroversion (degrees), associated procedures, preoperative and postoperative range of motion (degrees), as well as preoperative and postoperative outcome measures (Constant score, Rowe and Zarins score, pain scores, American Shoulder and Elbow Surgeons Shoulder score, University of California at Los Angeles shoulder score, Simple Shoulder Test score, Oxford shoulder and stability scores, and Western Ontario and McMaster Universities instability score). Two authors independently scored the methodological quality for each study, including risk of bias using the Downs and Black Study Quality Assessment Tool.[4] We modified this assessment tool by excluding questions pertaining to randomized controlled trials since our literature search did not produce any such studies. The maximum score, indicating good quality, was 9.

Results

We identified 195 unique articles after exclusion of duplicates. We excluded 151 articles based on title and abstract (Fig. 1). Forty-four articles were reviewed in more detail; of which, 22 were excluded. The remaining 22 studies were included in this systematic review. All 22 included studies were level IV evidence. Study quality as per Downs and Black criteria is presented in Table I. Overall, study quality was good and most studies had a low risk for bias based on the total Downs and Black scores (maximum of 9 for case series).

A total of 201 patients with 205 shoulders underwent arthroplasty for chronic glenohumeral dislocations (Table I). Of the 205 shoulders, there were 74 HA, 62 ATSA, and 69 RTSA. The mean age of patients ranged from 45 to 77.5 years across all studies. The duration of glenohumeral dislocation before operation ranged from 3 weeks to 12.7 years. A total of 11 studies reported on patients with chronic anterior GHD, 8 studies reported on chronic posterior GHD, and 3 studies included both chronic anterior and posterior GHD.

The most frequently performed concomitant procedure was ipsilateral glenoid bone grafting (n = 46 patients). Other procedures performed concurrently included posterior capsular plication (n = 13 patients), rotator cuff repair (n = 11), greater tuberosity fixation (n = 3), capsular shift (n = 3), labral repair (n = 2), contralateral osteochondral autograft reconstruction (n = 2), latissimus dorsi transfer (n = 1), open reduction internal fixation of a bony Bankart (n = 1), and pectoralis major transfer (n = 1). Forty-seven concomitant procedures (58%) were in patients treated with HA or ATSA. Thirty-four (42%) were in patients treated with RTSA.

Clinical outcomes

The mean follow-up ranged from 8 months to 9 years. Sixteen studies presented preoperative and postoperative range of motion data. All 16 of these studies showed improved range of motion postoperatively (Table I). The other outcome scores reported were Constant score (n = 9), pain score (n = 3), American Shoulder and Elbow Surgeons Shoulder score (n = 3), Rowe and Zarins (n = 2), Simple Shoulder Test (n = 2), Subjective score (n = 2), University of California at Los Angeles shoulder score (n = 1), visual analog scale (n = 1), average rating units (n = 1), Oxford shoulder and stability scores (n = 1), and Western Ontario and McMaster Universities instability index (n = 1). All studies demonstrated improved clinical outcome scores postoperatively. Nine of twenty-one studies reported postoperative satisfaction ratings; 116 of 143 (81%) patients had a rating of satisfactory or better.

A total of 31 reoperations (15%) were performed across all studies (Table I). Reoperations were performed for glenoid wear after HA (n = 11 patients), glenoid component loosening (n = 6), recurrent instability (n = 6), fracture (n = 4), infection (n = 3), and bone graft screw removal (n = 1). Of the 31 total reoperations, 14 were in patients treated with HA (45%), 9 in patients with ATSA (29%), and 8 were in patients treated with RTSA (26%). Additional complications treated nonoperatively included 15 cases of recurrent instability (subluxations and dislocations), 6 cases of glenoid notching, 5 cases of heterotopic ossification, 3 cases of glenoid loosening, 2 cases of median neuropathy, 1 axillary nerve palsy, and 1 postoperative humerus fracture; two patients sustained intraoperative humerus fractures that were managed with open reduction internal fixation and a long-stemmed prosthesis at the time of surgery.

Predictors of clinical outcomes

Gavriilidis et al[7] found that patients with more recent dislocations had better Constant scores and less pain postoperatively. Wooten et al[26] also suggested a trend toward better outcomes in patients that underwent surgery ≤1 year after their injury compared with those who had surgery ≥1 year after their injury.

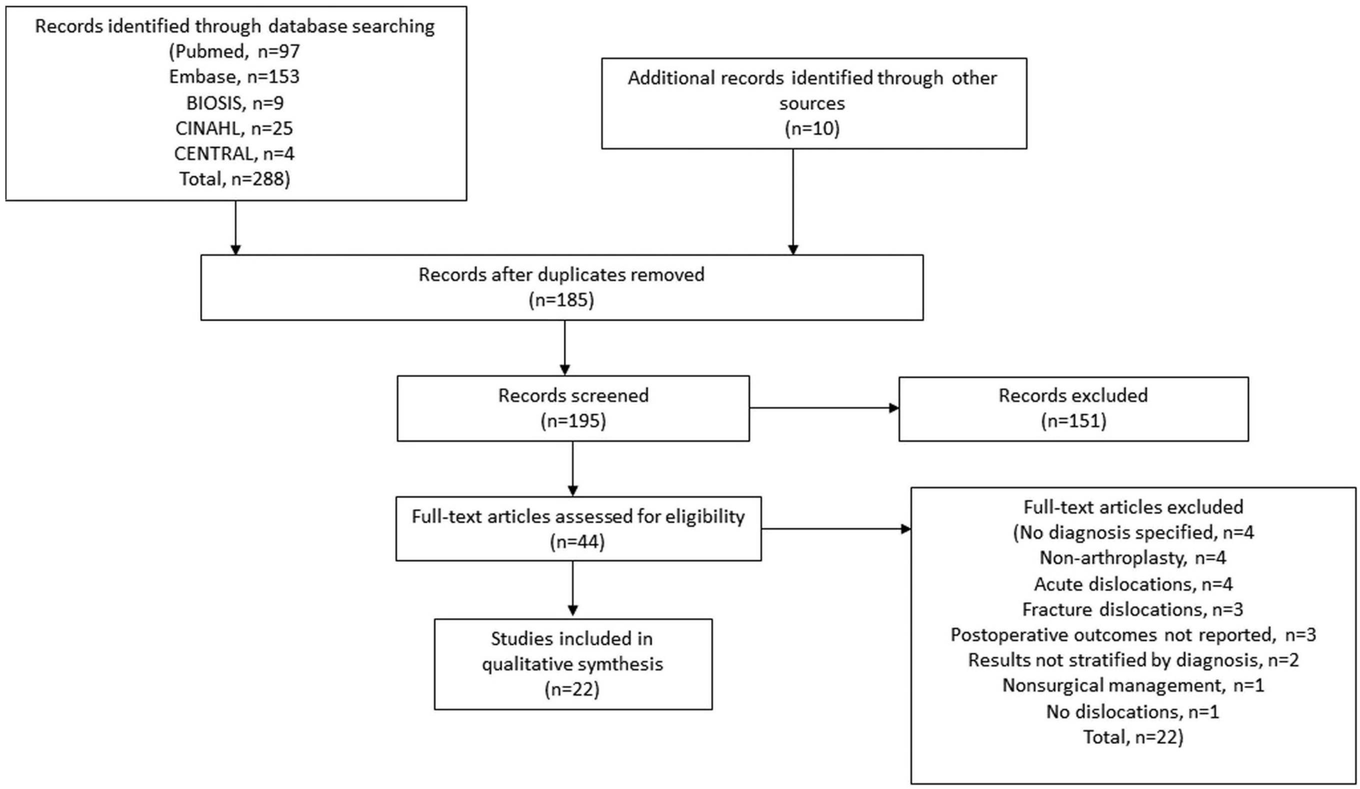

Figure 1 PRISMA flowchart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

On the other hand, Statz et al[22] found no significant difference in any outcome measure between patients treated <32 weeks vs. those treated ≥32 weeks from the time of injury.

Raiss et al[16] found no significant differences in Constant scores or range of motion between patients with chronic anterior GHD vs. patients with chronic posterior GHD treated with RTSA. No other studies reported on the impact that direction of dislocation has on outcomes.

Wooten et al[26] looked at the effect of humeral component retroversion in HA and ATSA on outcomes by performing a subgroup analysis of patients with 5-20° retroversion compared with those with 21-34° retroversion. They concluded that humeral version had little effect on outcome. No other studies examined the effect that humeral component version had on outcomes.

Wooten et al[26] also performed a subgroup analysis on 7 patients treated with ATSA and HA that had concomitant posterior capsule plication. They found that the addition of posterior capsule plication did not appear to impact outcomes. Conversely, they identified a trend toward worse outcomes in the 4 patients that underwent concomitant rotator cuff repair.[26] Statz et al[22] performed glenoid bone grafting in 7 of 12 shoulders (1 HA, 2 ATSA, 4 RTSA) with humeral head autograft. They concluded that addition of glenoid bone grafting did not affect any outcome measure. No additional studies examined the effect that concomitant surgical procedures have on outcomes.

Four studies performed subgroup analysis of outcomes between patients that underwent HA vs. ATSA.[8,18,21,26] Wooten et al[26] showed that their HA group yielded 4 excellent, 8 satisfactory, and 6 unsatisfactory results compared with 7 satisfactory and 7 unsatisfactory outcomes in the ATSA group. They reported 6 reoperations in the HA group (33%) and 3 reoperations in the ATSA group (21%). Hawkins et al[8] showed no significant difference in elevation, external rotation, or internal rotation in patients treated with HA (n = 9) vs. ATSA (n = 10). Three of their patients in the HA group (33%) had reoperations compared with none in the ATSA group. Rowe and Zarins[18] reported an average Rowe and Zarin's rating of 67.5 of 100 in their HA group (n = 2) compared with a rating of 90 of 100 in the ATSA group (n = 1); no reoperations were performed. Sperling et al[21] reported a postoperative pain score of 2.3 of 5 in the HA group (n = 6) vs. 3 of 5 in the ATSA group (n = 6). There were 4 satisfactory and 2 unsatisfactory outcomes in the HA group and 1 excellent, 2 satisfactory, and 3 unsatisfactory outcomes in the ATSA group. Two reoperations were performed in their HA group (33%) and 1 reoperation was performed in their ATSA group (17%).

One study compared outcomes between patients that underwent HA or ATSA vs. RTSA.[22] Statz et al[22] demonstrated that 9 patients that underwent RTSA collectively had better postoperative pain (1.8 vs. 2.6), American Shoulder and Elbow Surgeons Shoulder score (76 vs. 43), Simple Shoulder Test (7.4 vs. 3.5), and subjective scores (55 vs. 25) compared with patients with 10 ATSA/HA. The RTSA group also had better elevation (106° vs. 81°) and external rotation (46° vs. 21°) postoperatively compared with the ATSA or HA cohort. There were also significantly more episodes of instability in the ATSA/HA group compared with the RTSA group (6 vs. 0, $P = .0108$).

None of the studies in this review investigated how age, sex, or size of humeral head defect may impact outcomes after surgery.

Discussion

Our review found evidence that patients with chronic glenohumeral dislocations have improved clinical outcomes and range of motion after HA, ATSA, and RTSA at a long-term follow-up. There is some evidence that suggests RTSA may have superior outcomes and fewer complications compared with HA and ATSA. It is unclear

Table I
Study characteristics and results

Factors	Rowe et al. 1982[17]	Hawkins et al. 1987[8]	Pritchett et al. 1987[14]	Flatow et al. 1993[5]	Cheng et al. 1997[3]	Sperling et al. 2004[20]
Level of evidence	IV	IV	IV	IV	IV	IV
DB score*	6	7	6	6	8	8
Study sample	Chronic posterior GHD (N = 2) Chronic anterior GHD (N = 1)	Chronic posterior GHD (N = 16 including 19 shoulders)	Chronic posterior GHD (N = 3) Chronic anterior GHD (N = 4)	Chronic anterior GHD (N = 9)	Chronic posterior GHD (N = 7)	Chronic posterior GHD (N = 12)
Age, yr	Mean = 45.7 (range: 38-51)	Mean = 49.2 (range: 17-80)	Mean = 55 (range: 36-67)	Mean = 64 (range: 48-73)	Mean = 58 (range: 40-74)	Mean = 56 (range: 36-78)
Sex (male:female ratio)	1:2	32:8	5:2	6:11	3:4	6:6
Duration of dislocation before surgery	Mean = 12.7 yr (range: 2-33)	Mean = 12 mo	Mean = 69 mo (range: 2-432 mo)	Mean = 46.8 mo (24-72)	Mean = 23 mo (range: 1-86)	Mean = 26 mo (range: 4-88)
Procedure	HA (N = 2) ATSA (N = 1)	HA (N = 9) ATSA (N = 10)	HA (N = 4) ATSA (N = 3)	HA (N = 1) ATSA (N = 8)	ATSA (N = 7)	Uncemented HA (N = 5) Cemented HA (N = 1) Uncemented TSA (N = 4) Cemented TSA (N = 2)
Associated procedure(s)	None	Posterior capsular plication (N = 6)	None	ATSA: Glenoid bone grafting (N = 3) Rotator cuff repair (N = 2)	None	None
Average follow-up	4.9 yr (range: 2-10)	5.5 yr	2.3 yr	3.9 yr (range: 2-6)	27 mo	9 yr (range: 0.7-22 yr)
Range of motion	Not reported	Preoperative: Elevation: 105° (70-160°) External rotation: -40° (-10 to -60) Internal rotation: T12 (L4-T8) Postoperative: HA (N = 9): Elevation: 140° (range: 125-165) External Rotation: 30° (range: 24-41) Internal Rotation: L2 TSA (N = 6): Elevation: 145° (range: 112-168) External Rotation: 37 (range: 24-42) Internal Rotation: L1-T12 HA -> ATSA (N = 3): Elevation: 106°(98-112) External Rotation: 30° (22-34) Internal Rotation: L2 (L1-L3)	Not reported	Preoperative: Elevation: 101° (range: 80-130) External Rotation: 11° (0-25) Internal Rotation: T10 Postoperative: Elevation: 147° (range: 110-180) External Rotation: 69° (range 45-90)	Preoperative: Elevation: 76.7° External Rotation: -4° Internal Rotation: S2 Postoperative: Elevation: 109° External Rotation: 11.4° Internal Rotation: T10	Preoperative: Abduction: 82° External Rotation: -13° Internal Rotation: sacrum Postoperative: Abduction: 96° External Rotation: 28° Internal Rotation: L4
Outcome scores	Preoperative: Not reported Postoperative: Average rating units (0-100): HA (mean = 67.5, range: 60-75) TSA (mean = 90)	Not reported	Preoperative: Rowe & Zarins score: 50/100 Postoperative: Rowe & Zarins score: 71/100 Patient satisfaction: Excellent ≥90 (N = 0) Good 89-70 (N = 5) Fair 69-50 (n = 2) Poor <50 (N = 0)	Preoperative: Not reported Postoperative: ATSA: Patient satisfaction- Excellent (N = 4) Satisfactory (N = 4) HA: Patient satisfaction- Missing, patient lost to follow up (N = 1)	Preoperative: VAS (pain): 7.7 VAS (function):3.0 ASES: 20.1 Postoperative: VAS (pain): 3.5 VAS (function): 7.6 ASES: 55.6	Preoperative: HA: Pain score: 4.5/5 ATSA: Pain score: 4.6/5 Postoperative: HA: Pain score: 2.3/5 Satisfaction: Satisfactory (N = 4) Unsatisfactory (N = 2) ATSA: Pain score: 3/5 Satisfaction: Excellent (N = 1) Satisfactory (N = 2) Unsatisfactory (N = 3)
Reoperations	None	Conversion from HA to ATSA for glenoid wear (N = 3)	None	None	None	Revision for recurrent instability (N = 2 at 1.5 and 11 mo post-HA) Revision for component loosening (N = 1 at 14 yr post-ATSA)
Postoperative complications	None	Dislocation after ATSA, not treated (N = 1)	Axillary nerve palsy, recovered (N = 1)	Anterior subluxation (n = 1) No superior migration, component breakage or loosening	Posterior subluxation treated with orthosis (N = 1)	Median neuropathy, resolved (N = 1)

ADL, activities of daily living, *ASES*, American Shoulder and Elbow Surgeons score, *ATSA*, anatomic total shoulder arthroplasty, *DB*, Downs and Black score, *GHD*, glenohumeral dislocation, *HA*, hemiarthroplasty, *MVA*, motor vehicle accident, *N/A*, not applicable, *RTSA*, reverse total shoulder arthroplasty, *ROM*, range of motion, *SST*, Simple Shoulder Test, *TSH*, total shoulder arthroplasty, *UCLA*, University of California at Los Angeles Shoulder score, *VAS*, visual analog scale, *WOSI*, Western Ontario Shoulder Instability Index.

*Scores from the Downs and Black Study Quality Assessment Tool. A maximum score of 9 indicates good quality and low risk of bias for case series.

†Scoring with the Downs and Black Study Quality Assessment Tool was not applicable for case series.

Table I
Study characteristics and results *(continued)*

Matsoukis et al. 2006[12]	Ivkovic et al. 2007[9]	Raiss et al. 2009[15]	Gavriilidis et al. 2010[7]	Macaulay et al. 2011[11]	Schliemann et al. 2011[20]
IV	IV	IV	IV	IV	IV
7	N/A[†]	9	8	N/A[†]	8
Chronic anterior GHD (N = 11)	Chronic bilateral posterior GHD (N = 1 including 2 shoulders)	Chronic anterior GHD (N = 10)	Chronic posterior GHD (N = 11, including 12 shoulders)	Chronic anterior GHD (N = 2)	Chronic posterior GHD (N = 2)
Mean = 67.3 (range: 45-84)	Mean = 52	Mean = 67 (range: 51-75)	Mean = 49.8 ± 8.6	Mean = 77.5 (range: 73-82)	Mean = 53 (range: 30-86)
3:8	1:0	4:6	10:1	0:2	Not reported
> 3 weeks	3 mo	> 6 weeks	14.5 mo ± 23.3	Mean = 9 mo	Mean = 66 d (range: 0-365)
Cemented HA (N = 7) Cemented TSA (N = 4)	HA (N = 1)	HA (N = 10)	HA (N = 10) ATSA (N = 2)	RTSA (N = 2)	HA (N = 1) RTSA due to rotator cuff tear (N = 1)
Glenoid bone grafting (N = 4) Greater tuberosity fixation (N = 2)	Contralateral osteochondal autograft reconstruction (N = 1)	Rotator cuff repair (N = 4) Capsular shift (N = 3) Labral repair (N = 2) ORIF Bankart (N = 1)	Latissimus dorsi transfer + HA (N = 2) Open rotator cuff repair + HA (N = 1) Pectoralis major transfer + HA (N = 1)	Glenoid bone grafting (N = 2)	None
47.7 mo (24-86)	3 yr	24 mo (range: 12-42)	37.4 ± 6.8 mo	1 yr	55 mo (11-132)
Preoperative: Elevation: 48.6° External Rotation: 13.2° Postoperative: Elevation: 90.0° External Rotation: 25.5°	Preoperative: Flexion: 90° Abduction: 30° Internal Rotation: sacrum External Rotation: -20° Postoperative: Flexion: 140 Abduction: 90 Internal Rotation: L5 External Rotation: 45	Preoperative: Flexion: 45.1° (range 0-100) Abduction: 30.8° (range 0-90) External rotation: 7.7° (range 0-30) Internal rotation: (Range Lateral thigh-L3) Postoperative: Flexion: 134.2° (range 70-170) Abduction: 126.5° (range 40-170) External rotation: 34.1° (range 10-60) Internal rotation: (range Gluteal muscle-T7)	Preoperative: Flexion: 84.2 ± 22.3, Abduction: 55.4 ± 21, External Rotation: −6.7 ± 20.2 Postoperative: Flexion: 125 ± 47 Abduction: 95.8 ± 53.3 External Rotation: 36.7 ± 19.7	Preoperative: Elevation: 30° External Rotation: 0° Internal Rotation: sacrum Postoperative: Elevation: 140°	Not reported
Preoperative: Constant score (age/gender adjusted): 28.2 Postoperative: Constant score (age/gender adjusted): 59.8 Satisfaction: Excellent (N = 2) Good (N = 6) Fair (N = 3)	Preoperative: Not reported Postoperative: Constant score- 55	Preoperative: Constant score-20 (range 0-52) Postoperative: Constant score- 61 (range): 35-87) Patient Satisfaction- Very satisfied (N = 4) Satisfied (N = 4) Disapointed (N = 1) Very disappointed (N = 1)	Preoperative: Not reported Postoperative: Constant score overall: Mean = 59.5 ± 21.6) Overall adjusted for age and gender: Mean = 67.1 ± 24.1%) Constant pain subscore: 12.8 ± 3.9 Constant ADL subscore: 14.3 ± 6.1 Constant ROM subscore: 26 ± 9 Constant strength subscore: 9.3 ± 3.6 for strength More resent dislocations had better Constant scores and less pain.	Not reported	Preoperative: Not reported Postoperative: Constant score (age/gender adjusted): 51 Rowe and Arins score: 56/100
Glenoid component removal (N = 1) Bone graft screw removal (N = 1)	None	Conversion to TSA (N = 1) Refixation of Subscapularis/ coracoid transfer (N = 1)	Removal of the metal-backed uncemented glenoid component for poly dissociation and implantation of a cemented all-polyethylene glenoid component at 36 weeks postoperatively (N = 1)	None	None
Anterior subluxation (N = 1) Anterior Dislocation (N = 3) glenoid loosening (N = 3)	None	Glenoid erosion (N = 1) Redislocation (N = 1)	None	None	None

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Table I
Study characteristics and results *(continued)*

Torrens et al. 2012[23]	Venkatachalam et al. 2014[25]	Werner et al. 2014[26]	Wooten et al. 2014[27]	Ji et al. 2016[6]
IV	IV	IV	IV	IV
N/A[†]	N/A[†]	9	8	N/A[†]
Chronic bilateral posterior GHD (N = 1)	Chronic anterior GHD (N = 1)	Chronic anterior GHD (N = 21)	Chronic posterior GHD (N = 32)	Chronic anterior GHD (N = 1)
Mean = 45	Mean = 58	Mean = 71 (range 50-85)	Mean = 54 (range: 25-79 yr)	68
1:0	1:0	3:18	19:13	0:1
Mean = 3 mo	Mean = 6 mo	Mean = 6 mo (3-11)	Mean = 24 mo (range: 3-88)	Mean = 4 mo
HA (N = 1)	Cemented HA (N = 1)	RTSA (N = 21)	HA (N = 18) ATSA (N = 14) Neer-II metal-backed glenoid component cemented (N = 3) Cofield all-polyethylene component cemented (N = 9) Cofield metal-backed ingrowth component (N = 2)	RTSA (N = 1)
Contralateral osteochondral autograft reconstruction (N = 1)	Coracoid osteotomy/bone grafting (N = 1)	Glenoid bone grafting (N = 21)	Rotator cuff repair (N = 4) Posterior capsule plication (N = 7)	Glenoid autograft (N = 1) Greater tuberosity osteotomy and fixation (N = 1)
2 yr	24 mo	4.9 yr (2-10)	8.2 yr (range: 0.7-31)	3 yr
Preoperative: Flexion: 60 Postoperative: Flexion: 160, External rotation: 45, Internal rotation: L3	Preoperative: Flexion: 70º Abduction: 30º External Rotation: 15º (fixed) Postoperative: Flexion: 160º Abduction: 155º External Rotation: 10º Internal Rotation: L3	Preoperative: Elevation: 35º Abduction: 25º External Rotation: 2.4º Postoperative: Elevation: 128º Abduction: 113º External Rotation: 8.4º	Preoperative: External rotation: -15 (range -70-20) Abduction: 82 Internal rotation: sacrum Postoperative: External rotation: 50 (range: -60-90) Abduction: 90 Internal rotation: L4	Preoperative: not reported Postoperative: Forward elevation: 30, Abduction: 40 External rotation: 10
Not reported	Preoperative: Oxford Shoulder score : 32 Oxford instability index: 20 WOSI :18 Postoperative: Oxford Shoulder score: 48 Oxford Stability score: 46 WOSI: 25	Preoperative: Constant score: 5.7 (range: 0-22) Postoperative: Constant score: 57.2 (range: 26-79) Outcome rated as Excellent (N = 10) Good (N = 8) and Fair (N = 3)	Preoperative: Pain score: median = 4 (range: 3-5) Postoperative: Pain score: median = 3 (range: 1-5) 5-20º humeral retroversion had postoperative pain score of 3, External Rotation 40º, Elevation 90º 21-34º humeral retroversion had postoperative pain score of 2, External Rotation 50º, Elevation 90º Concomitant rotator cuff repair had postoperative pain score of 3, External rotation 15º, elevation 90º Concomitant posterior capsule plication had postoperative pain score of 3, external rotation 30º, elevation 110º HA: Patient satisfaction- Excellent (N = 4) Satisfactory (N = 8), Unsatisfactory (n = 6) TSA: Patient satisfaction- Satisfactory (N = 7), Unsatisfactory (n = 7)	Preoperative: ASES: 0 UCLA 5 SST: 0 Postoperative: ASES: 60 UCLA: 26 SST: 7
None	None	Conversion of RTSA to HA due to glenoid loosening(N = 1) Revision glenoid component for traumatic loosening (N = 1)	HA: Revision to TSA with posterior capsule plication, at 2 and 11 mo. postoperatively due to recurrent posterior subluxation or dislocation (N = 2) Resection because of instability in the setting of Parkinson disease and another for infection (N = 2) Revision to TSA due to pain from glenoid wear at 3 / 10 yr (N = 2) TSA: Revision due to humeral fracture that went to nonunion (N = 1) Revision due to infection at 7mo (N = 1) Revision to HA due to glenoid loosening after 14 yr (N = 1)	None
None	None	Notching (N = 6) Heterotopic ossification (N = 5)	Median neuropathy, resolved (N = 1)	None

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Table I
Study characteristics and results *(continued)*

Van Tongel et al. 2016[24]	Olszewski et al. 2017[13]	Raiss et al. 2017[16]	Statz et al. 2017[22]	Frias et al. 2018[6]
IV	IV	IV	IV	IV
7	N/A[†]	9	9	8
Chronic anterior GHD (N = 6)	Chronic anterior GHD (N = 1)	Chronic anterior GHD (N = 18) Chronic posterior GHD (N = 4)	Chronic anterior GHD (N = 19)	Chronic anterior GHD (N = 6)
Mean = 73 (range: 65-86)	49	Mean = 71(range: 51-91)	Mean = 62 (range: 34-80)	Mean = 69.5 (range: 64-80)
4:2	1:0	7:15	3:16	1:5
Mean = 4.5 mo (range: 1-12)	> 1 yr	Mean = 23 mo (range: 1-148)	Median = 32 weeks	Mean = 1.6 mo (range: 1.2-2.3)
RTSA (N = 6)	RTSA (N = 1)	RTSA (N = 22)	HA (N = 3) ATSA (N = 7) RTSA (N = 9)	RTSA (N = 6)
Allograft bone grafting (N = 1)	None	Glenoid bone grafting (N = 4 anterior; N = 1 posterior)	Glenoid bone grafting (N = 1 HA, N = 2 ATSA, N = 4 RTSA)	Glenoid bone grafting (N = 1)
39 mo (range: 12-90)	24 mo	Mean = 3.5 yr (range: 2-9)	7.1 yr (range: 2-30)	8 mo (range: 6-16)
Not reported	Preoperative: Forward flexion: 50° Abduction: 35° External rotation:0° Internal rotation: to the side Postoperative: Forward flexion: 160° Abduction: 90° External rotation:30°	Preoperative: Forward flexion: 37.7° Abduction: 35° External rotation:-0.5° Postoperative: Forward flexion: 103° Abduction: 35° External rotation:14.7° Internal rotation: Increased significantly (*P*<.03)	PreoperatiTSA: Elevation: 57° External rotation:10° Internal rotation: Greater trochanter RTSA: Elevation:43° External rotation: -11° Internal rotation: Iliac crest Postoperative: Hemi/ATSA: Elevation: 81° External rotation: 21° Internal rotation: Sacroiliac joint RTSA: Elevation: 106° External rotation:46° Internal rotation: sacrum	Preoperative: Not reported Postoperative: Flexion: 105° (range: 55-170) External rotation: 18° (range: -0.5-26) Internal Rotation: L3 (buttock-T12)
Preoperative: Constant score: 33 (range: 17-47) Postoperative: Constant score: 76 (range: 55-90)	Preoperative: Subjective function-90% Postoperative: Not reported	Preoperative: Constant score- 13.6 Postoperative: Constant score- 47.4 Patient satisfaction- Very Good (N = 8) Good (N = 5) Satisfactory (N = 5) Unsatisfactory (N = 4)	Preoperative: Hemi/ATSA: Pain score- 4.6/5 RTSA: Pain score- 4.8/5 Postoperative: Hemi/ATSA: Pain score- 2.6/5 ASES- 43 SST- 3.5/12 Subjective- 25/100 RTSA: Pain score- 1.8/5 ASES- 76 SST- 7.4/12 Subjective-55/100	Preoperative: Not reported Postoperative: Constant score- 65 (range: 35-80)
None	None	Conversion to HA for glenoid failure in all 4 anterior bone grafted cases (N = 4 at 1 week, 1 mo, 9 mo, 2 years) Revision humeral component for humeral fracture (N = 1) Resection arthroplasty for infection (N = 1)	Open reduction (N = 2 ATSA) Conversion to ATSA for glenoid wear (N = 1 HA)	None
None	None	Recurrent instability (N = 1)	Intraoperative humeral shaft fracture (N = 2 RTSA) Postoperative humeral shaft fracture (N = 1 RTSA) Moderate/ severe subluxation or dislocation (N = 2 HA and N = 4 ATSA) Recurrent instability after revision open reduction (N = 1 ATSA)	None

whether time interval between injury and arthroplasty, degree of humeral component retroversion, direction of dislocation, or addition of concomitant procedures have any effect on outcomes. We did not find any studies that examined the effect of age, sex, or percentage of humeral head defect on postoperative outcomes.

Gavriilidis et al[7] reported better clinical outcomes in patients with a shorter interval between surgery and injury; however, they did not provide any data regarding that subgroup analysis. Wooten et al[26] also reported a trend toward better outcomes in patients who underwent surgery ≤1 year after their injury compared with those ≥1 year; however, their subgroup analysis was underpowered to detect such differences. In contrast, Statz et al[22] found no significant difference in outcome measures between patients treated <32 weeks from the time of injury vs. those treated ≥32 weeks. Owing to the low quality of evidence and conflicting results that we reviewed, it is unclear if time interval between injury and surgery has any effect on clinical outcomes.

One study by Raiss et al[16] found no significant difference in any outcome measure between patients treated with RTSA for chronic anterior GHD compared with chronic posterior GHD. No other studies examined the effect that direction of dislocation may have on outcomes.

Wooten et al[26] also performed a subgroup analysis on patients with different amounts of humeral component retroversion in patients treated with HA and ATSA. They found no difference in outcomes between their two groups; however, the analysis was also underpowered to detect such differences. No additional studies investigated the effect that humeral component retroversion has on outcomes.

Two studies examined the effect that concomitant procedures may have on postoperative outcomes.[22,26] Wooten et al[26] reported that concomitant posterior capsule plication did not affect outcomes, whereas concomitant rotator cuff repair detrimentally affected outcomes. However, as previously stated, their subgroup analysis was underpowered. Statz et al reported that glenoid bone grafting did not significantly impact outcome scores, range of motion, or postoperative complication rates.[22]

There were 4 studies that performed subgroup analyses of patients treated with HA and those treated with ATSA.[8,18,21,26] None of those 4 studies reported a difference in outcomes between the two groups.

Statz et al[22] compared the outcome of patients that had HA or ATSA versus those that had RTSA. RTSA showed superior outcome scores and range of motion. However, the only statistically significant difference between the two groups was the rate of postoperative instability. The lack of statistical differences was likely owing to the small number of patients in their study. No other studies compared outcomes between patients with HA or ATSA and those with RTSA.

Thirty-one reoperations were performed for the 205 cases of shoulder arthroplasty included in this study. RTSA had the lowest reoperation rate with 8 reoperations performed of 69 surgeries (11.6%). Hemiarthroplasty had the highest rate of reoperation with 14 of 74 surgeries (19%). ATSA was in the middle with 9 reoperations of 62 surgeries (14.5%).

The results of arthroplasty when used to treat chronic GHD can be variable for a number of important reasons. Soft-tissue contractures, rotator cuff tears, as well as humeral and glenoid bone defects can make balancing and implant stability a challenge. Some surgical techniques that authors have used to achieve successful outcomes include capsular plication and increasing or decreasing humeral component retroversion to balance or compensate for soft-tissue contractures. In addition, several authors perform glenoid bone grafting in the setting of glenoid bone defects to achieve stable base plate fixation. Oftentimes this means using the humeral head as autograft fixed with screws. In recent years, RTSA has become a popular option in treating chronic GHD. The semiconstrained nature of these prostheses and its successful use in patients with rotator cuff tears, soft tissue contractures, and glenoid bone loss make RTSA an attractive option with predictable results.

To our knowledge this is the first systematic review of studies examining outcomes and predictors of outcomes following glenohumeral arthroplasty used to treat chronic glenohumeral dislocations. We recognize that there are several limitations of this study. First, the heterogeneity in reported outcome measures across the studies prevented us from performing a meta-analysis. Second, the lack of a standardized rehabilitation protocol could potentially be a confounding variable with different immobilization and therapy regimens. Finally, all the studies included in this review were level IV evidence, which inherently limits our ability to draw conclusions.

Conclusion

Our study demonstrates that successful clinical outcomes can be achieved with arthroplasty in chronic glenohumeral dislocations. RTSA may have improved outcomes compared with HA or ATSA. It is unclear whether duration of dislocation, direction of dislocation, addition of concomitant procedures, or humeral component retroversion have an effect on outcomes. This study provides a comprehensive and up-to-date review of outcomes after glenohumeral arthroplasty when used to treat chronic glenohumeral dislocations. Well-designed prospective studies are needed to further understand the impact that patient and surgical factors may have on outcomes.

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References

1. Akinci O, Kayali C, Akalin Y. Open reduction of old unreduced anterior shoulder dislocations: a case series including 10 patients. Eur J Orthopaedic Surg Traumatol 2010;20:123-9. https://doi.org/10.1007/s00590-009-0495-x.
2. Aydin N, Enes Kayaalp M, Asansu M, Karaismailoglu B. Treatment options for locked posterior shoulder dislocations and clinical outcomes. EFORT Open Rev 2019;4:194-200. https://doi.org/10.1302/2058-5241.4.180043.
3. Cheng SL, Mackay MB, Richards RR. Treatment of locked posterior fracture-dislocations of the shoulder by total shoulder arthroplasty. J Shoulder Elbow Surg 1997;6:11-7.
4. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health 1998;52:377-84.
5. Flatow EL, Miller SR, Neer CS 2nd. Chronic anterior dislocation of the shoulder. J Shoulder Elbow Surg 1993;2:2-10.
6. Frias MSH, Torres TP, Lourenco P. Reversed Shoulder Arthroplasty on Chronic Glenohumeral Dislocations: A small Retrospective Case Series. J Musculoskelet Disord Treat 2018;4:1-4. https://doi.org/10.23937/2572-3243.1510061.
7. Gavriilidis I, Magosch P, Lichtenberg S, Habermeyer P, Kircher J. Chronic locked posterior shoulder dislocation with severe head involvement. Int Orthop 2010;34:79-84. https://doi.org/10.1007/s00264-009-0762-9.
8. Hawkins RJ, Neer CS 2nd, Pianta RM, Mendoza FX. Locked posterior dislocation of the shoulder. J Bone Joint Surg Am 1987;69:9-18.
9. Ivkovic A, Boric I, Cicak N. One-stage operation for locked bilateral posterior dislocation of the shoulder. J Bone Joint Surg Br 2007;89:825-8. https://doi.org/10.1302/0301-620X.89B6.18842.
10. Ji JH, Shafi M, Jeong JJ, Ha JY. Reverse total shoulder arthroplasty in the treatment of chronic anterior fracture dislocation complicated by a chronic full thickness retracted rotator cuff tear in an elderly patient. J Orthop Sci 2016;21:237-40. https://doi.org/10.1016/j.jos.2015.06.004.

11. Macaulay AAG, Raymond M, Levine WN. Reverse Total Shoulder Replacement in Patients with Severe Glenoid Bone Loss. Oper Tech Orthopaedics 2011. https://doi.org/10.1053/j.oto.2010.08.001.
12. Matsoukis J, Tabib W, Guiffault P, Mandelbaum A, Walch G, Nemoz C, et al. Primary unconstrained shoulder arthroplasty in patients with a fixed anterior glenohumeral dislocation. J Bone Joint Surg Am 2006;88:547-52. https://doi.org/10.2106/JBJS.E.00368.
13. Olszewski N, Gustin M, Curry EJ, Li X. Management of Complex Anterior Shoulder Instability: a Case-Based Approach. Curr Rev Musculoskelet Med 2017;10:480-90. https://doi.org/10.1007/s12178-017-9438-z.
14. Pritchett JW, Clark JM. Prosthetic replacement for chronic unreduced dislocations of the shoulder. Clin Orthop Relat Res 1987:89-93.
15. Raiss P, Aldinger PR, Kasten P, Rickert M, Loew M. Humeral head resurfacing for fixed anterior glenohumeral dislocation. Int Orthop 2009;33:451-6. https://doi.org/10.1007/s00264-007-0487-6.
16. Raiss P, Edwards TB, Bruckner T, Loew M, Zeifang F, Walch G. Reverse arthroplasty for patients with chronic locked dislocation of the shoulder (type 2 fracture sequela). J Shoulder Elbow Surg 2017;26:279-87. https://doi.org/10.1016/j.jse.2016.05.028.
17. Raiss P, Felix Z, Pons-Villanueva J, Smithers CJ, Loew M, Walch G. Reverse arthroplasty for osteoarthritis and rotator cuff deficiency after previous surgery for recurrent anterior shoulder instability. Int Orthopaedics 2014;38:1407-13. https://doi.org/10.1007/s00264-014-2325-y.
18. Rowe CR, Zarins B. Chronic unreduced dislocations of the shoulder. J Bone Joint Surg Am 1982;64:494-505.
19. Sahajpal DT, Zuckerman JD. Chronic glenohumeral dislocation. J Am Acad Orthop Surg 2008;16:385-98. https://doi.org/10.5435/00124635-200807000-00004.
20. Schliemann B, Muder D, Gessmann J, Schildhauer TA, Seybold D. Locked posterior shoulder dislocation: treatment options and clinical outcomes. Arch Orthop Trauma Surg 2011;131:1127-34. https://doi.org/10.1007/s00402-011-1310-9.
21. Sperling JW, Pring M, Antuna SA, Cofield RH. Shoulder arthroplasty for locked posterior dislocation of the shoulder. J Shoulder Elbow Surg 2004;13:522-7. https://doi.org/10.1016/j.jse.2004.02.012.
22. Statz JM, Schoch BS, Sanchez-Sotelo J, Sperling JW, Cofield RH. Shoulder arthroplasty for locked anterior shoulder dislocation: a role for the reversed design. Int Orthopaedics 2017;41:1227-34. https://doi.org/10.1007/s00264-017-3450-1.
23. Torrens C, Santana F, Melendo E, Marlet V, Caceres E. Osteochondral autograft and hemiarthroplasty for bilateral locked posterior dislocation of the shoulder. Am J Orthop (Belle Mead Nj) 2012;41:362-4.
24. Van Tongel A, Claessens T, Verhofste B, De Wilde L. Reversed shoulder arthroplasty as treatment for late or ancient chronic glenohumeral dislocation. Acta Orthop Belg 2016;82:637-42.
25. Venkatachalam S, Nicolas AP, Liow R. Treatment of chronic anterior locked glenohumeral dislocation with hemiarthroplasty. Shoulder Elbow 2014;6:100-4. https://doi.org/10.1177/1758573213518498.
26. Werner BS, Bohm D, Abdelkawi A, Gohlke F. Glenoid bone grafting in reverse shoulder arthroplasty for long-standing anterior shoulder dislocation. J Shoulder Elbow Surg 2014;23:1655-61. https://doi.org/10.1016/j.jse.2014.02.017.
27. Wooten C, Klika B, Schleck CD, Harmsen WS, Sperling JW, Cofield RH. Anatomic shoulder arthroplasty as treatment for locked posterior dislocation of the shoulder. J Bone Joint Surg Am 2014;96:e19. https://doi.org/10.2106/JBJS.L.01588.