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Outcomes of Total Shoulder Arthroplasty With Posterior Capsular Plication

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Abstract

Background: Glenoid loosening and instability are among the most common complications after anatomic total shoulder arthroplasty (TSA), resulting in poor function. Posterior instability is one contributing factor. The purpose of this study is to report the clinical and radiographic outcomes of a series of patients treated with posterior capsule plication for intraoperative posterior instability during TSA. It is hypothesized that patients undergoing this procedure will have improvement in posterior stability intraoperatively while not limiting their ROM postoperatively.

Methods: Patients of the senior author were identified who had undergone TSA with posterior capsule plication from 2014 to 2015 based on Current Procedural Terminology (CPT) codes. Their records and preoperative radiographs were retrospectively reviewed for demographic data and preoperative range of motion (ROM) which was documented in the clinic notes. Patients were then evaluated postoperatively to determine the outcomes after TSA with posterior capsule plication. Final follow-up was conducted via telephone survey.

Results: Nineteen patients were identified for review; however, only 14 had all imaging available. The mean age at the time of surgery was 63 years. There were 2 A1, 6 B1, and 6 B2 Walch-type glenoids based on preoperative imaging. All but one had equivalent or better ROM for active forward elevation and external rotation postoperatively. One patient required return to operating room at 5 months after developing adhesive capsulitis.

Conclusion: This study indicates that the use of posterior capsule plication during TSA is a safe method to address posterior subluxation, while still allowing for improved ROM postoperatively.

Keywords

Posterior plication, total shoulder arthroplasty, posterior instability

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Introduction

Total shoulder arthroplasty (TSA) has become an increasingly common procedure for treating glenohumeral arthritis with good results in patients under 50 years and older patient populations, with surgeons nearly doubling the number of TSA from 2005 to 2013.[1–5] In many cases of glenohumeral arthritis, there is posterior subluxation of the humeral head with posterior glenoid wear, which can be challenging for the surgeon. Walch classified glenoid morphology into 3 major groups. The Type B glenoids, particularly B2, provide particular challenges to TSA. Posterior glenoid erosion and posterior humeral head subluxation have been associated with worse outcomes after TSA.[6,7] Glenoid loosening and instability are among the most common complications after TSA, resulting in increased pain and poor function.[8–10] Persistent posterior humeral head subluxation may lead to eccentric posterior loading of the glenoid component with accelerated polyethylene wear and subsequent glenoid loosening.[11–13]

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Several strategies have been proposed to address the challenge of the posterior glenoid wear including eccentric reaming, posterior bone grafting, posteriorly augmented glenoid components, soft tissue balancing, and reverse TSA.[14–16] Eccentric reaming has been found to have favorable results as reported by Gerber in a series of 23 TSA where eccentric reaming was used to address glenoid retroversion and posterior humeral subluxation with posterior glenoid wear.[12] However, eccentric reaming has its limits with studies showing that only up to 15° of retroversion can be safely corrected by this method.[14–18] Posterior bone grafting is another option to assess the problem of posterior glenoid wear; however, this has complications of graft failure, hardware complication, and glenoid loosening.[15,16,19–22] Augmented glenoid components are another method of addressing posterior glenoid bone loss, but clinical studies are sparse at this time.[15,16] Reverse TSA has also been described as a method of addressing glenoid deficiency. In a study by Mizuno of reverse TSA for the treatment of primary glenohumeral osteoarthritis with a biconcave glenoid, there were improvements in motion and Constant scores. However, there was also a 15% complication rate including 1 case of loosening of the glenoid component.[23] As a result of the higher rate of complication, reverse TSA has generally been recommended for older more sedentary patients.[14,16] Soft tissue balancing is also an important component of managing posterior humeral head subluxation and posterior glenoid wear. Posterior capsulorraphy has been described as a technique to address this problem.[24] In a study by Walch, 9 patients also underwent posterior capsulorraphy at the time of TSA if there was static posterior subluxation noted intraoperatively. These patients were noted to have poor forward elevation postoperatively.[7] However, there is a paucity of clinical studies evaluating this technique and its outcomes particularly focused on postoperative range of motion (ROM).

The purpose of this study is to report the clinical and radiographic outcomes of a series of patients treated with posterior capsule plication for persistent intraoperative posterior instability during TSA. It is hypothesized that patients undergoing this procedure will have improvement in posterior stability and improved ROM postoperatively.

Methods

After approval by the institution's International Review Board, the records of the senior author were reviewed to identify patients who had undergone anatomic TSA with posterior capsule plication/capsulorraphy. Billing records were searched by CPT code for patients who had undergone TSA (23 472) in conjunction with posterior capsule plication (23 465) from 2014 to 2015, and operative reports reviewed to confirm posterior capsular plication had been performed for intraoperative instability assessed on examination. Once these patients had been identified, their records were retrospectively reviewed for demographic data and preoperative ROM which was documented in the clinic notes. Preoperative radiographs were reviewed if available to determine glenoid morphology classification according to Walch. The adapted humeral subluxation index (HSI) was calculated and used to determine humeral head subluxation based on preoperative radiographs by either fellowship-trained orthopedic surgeon or orthopedic resident.[12,25] Position of the humeral head was calculated by measuring the percentage of humeral head resting posterior to the midline of the glenoid on an axillary radiograph as an HSI. An index of >55% was considered posterior subluxation, 45% to 55% as centered and <45% as anterior subluxation. Operative records were also reviewed. During this time period, it was senior author's approach to examine shoulder motion intraoperatively including posterior and anterior stability and perform a posterior capsular plication if posterior instability noted on intraoperative examination. Posterior plication was completed with the use of a #2 nonabsorbable suture in a square purse-string stich of the posterior capsule. One to 2 sutures were placed based on repeat examination until desired stability was achieved (Figure 1). The desired stability is to achieve approximately <50% posterior translation or "shuck." The intraoperative algorithm involves first attaining the best appropriate soft tissue tensioning through component sizing. All trial components were placed in as anatomic position as possible including utilizing an anatomic version for the humeral neck cut and placing the humeral head eccentricity to provide as much coverage of the humeral neck as possible. Following this, testing of anterior–posterior translation in neutral rotation with trials in place was carried out. If the translation is greater than 50% and the sizing is appropriate (ie, increasing component size would result in a prosthesis that was "nonanatomic") then one should proceed with posterior plication. A single purse-string box stitch was placed. The shoulder stability was then retested after reinsertion of the trial components. If the shoulder was deemed appropriately tensioned, final component placement was carried out. If the tension was still deemed inappropriate, a second suture was placed. The final components were then placed and closure with robust subscapularis repair was completed in a typical fashion.

Patients were then prospectively evaluated in the office postoperatively to determine the outcomes after TSA with posterior capsule plication. The primary outcome measure was ROM including active and passive forward elevation and external rotation. Preoperative radiographs when available were also retrospectively

reviewed to evaluate the position of the humeral head component with respect to the glenoid. Final follow-up was conducted via a telephone interview to determine whether there had been any dislocation events, subjective changes in ROM and strength, as well as need for any additional surgeries. Motion results were measured at the time of last in-person follow-up and then over teleconference continued ROM was verbally confirmed to ensure that no patient felt as though they had lost any ROM.

Results

Nineteen patients out of a possible 138 were identified as having undergone anatomic TSA with posterior capsule plication by the senior author in a 2-year period. However, 2 patients lacked follow-up information beyond 6 months, due to death and loss to follow-up, and so were excluded from the data series. There were 3 women and 14 men. Average patient age at the time of surgery was 62 years (range 48–76 years).

Thirteen patients had preoperative radiographs available for review. Based on preoperative axillary imaging and Walch classification, there were 2 type A1 glenoids, 6 type B1 glenoids, and 5 type B2 glenoids. There were no type A2 or C glenoids. Four patients did not have preoperative radiographs available for review. In all cases, posterior capsule plication had been performed intraoperatively for persistent mild posterior instability evaluated intraoperatively as determined by the senior author and surgeon despite appropriate final component size and positioning. Average preoperative active forward elevation and active external rotation were 91° (range 30°–150°) and 15° (range −20° to 45°), respectively. Time at most recent follow-up ranged from 8 to 62 months with an average follow-up of 30.7 months. Radiographic and in-person follow-up with all patients were the same (mean: 8.9 months, range: 1.6–21.6). The HSI preoperatively was calculated for 14 of 19 patients who had axillary radiographs available. The humeral head was classified as centered in 6 patients (HSI range: 45%–55%), posterior in 7 of 14 patients (range 56%–72%), and anteriorly subluxated (41%) in 1 patient. Average postoperative forward elevation improved to 131° (range 90°–160°), and average postoperative external rotation improved to 51° (range 0°–75°) (Table 1). All patients noted increased ROM with the exception of one who required return to the operating room (OR) at 5 months postoperatively after developing adhesive capsulitis in the postoperative shoulder. Arthroscopic capsule release and manipulation under anesthesia was performed for this complication. There were no instances of dislocation or gross instability postoperatively. Final evaluation of patients was conducted via a teleconference survey. Two of the 19 patients were deceased at the time of contact so could not be evaluated. Of the remaining 17, 12 responded. Teleconference of the patients that could be reached (12/19) was a mean of 45.2 months with a range of 34.0 to 64.2 months. None had experienced any episodes of dislocation or any clinically noticeable decrease in ROM or strength, and they had not undergone any additional procedures on the operative shoulder.

Table 1. Patient Demographics.

ID	Age at Surgery	Sex	Side	Glenoid Type	Preoperative HSI (°)	Follow-up (mo)
1	71	F	R	B2	52	12
2	65	F	L	A1	48	41
3	48	M	R	B2	72	8
4	62	F	R	NA	NA	62
5	55	M	L	A1	54	58
6	64	M	R	NA	NA	54
7	62	M	L	B1	41	18
8	74	M	L	B1	58	50
9	56	M	R	B2	63	45
10	50	M	R	NA	NA	22
11	76	M	L	B1	45	41
12	59	M	R	B1	56	39
13	71	M	L	B2	59	37
14	63	M	L	B1	62	36
15	63	M	L	B2	55	12
16	50	M	R	B1	71	8
17	72	M	R	NA	NA	34

Abbreviations: F, female; HSI, humeral subluxation index; L, left; M, male; NA, not applicable; R, right.

Discussion

Posterior glenoid wear and posterior humeral head subluxation remains challenging to treat. Several methods have been proposed to address this problem at the time of surgery, including eccentric reaming, glenoid bone grafting, augmented glenoid components, and soft tissue balancing. Posterior capsule plication is one method of soft tissue balancing that has been described in the literature, but there is very little information regarding the outcomes after this procedure when performed in combination with TSA. Walch reported on 9 patients who underwent posterior capsulorraphy for persistent intraoperative posterior instability, but these patients experienced significantly worse forward elevation postoperatively.[7] The results of this study contradict those reported by Walch in that we demonstrate improved active forward elevation from 91° to 132° and improved external rotation from 15° to 51°, rather than a decrease. One patient of the 17 in our cohort developed restricted ROM in the postoperative shoulder requiring return to the OR for arthroscopic lysis of

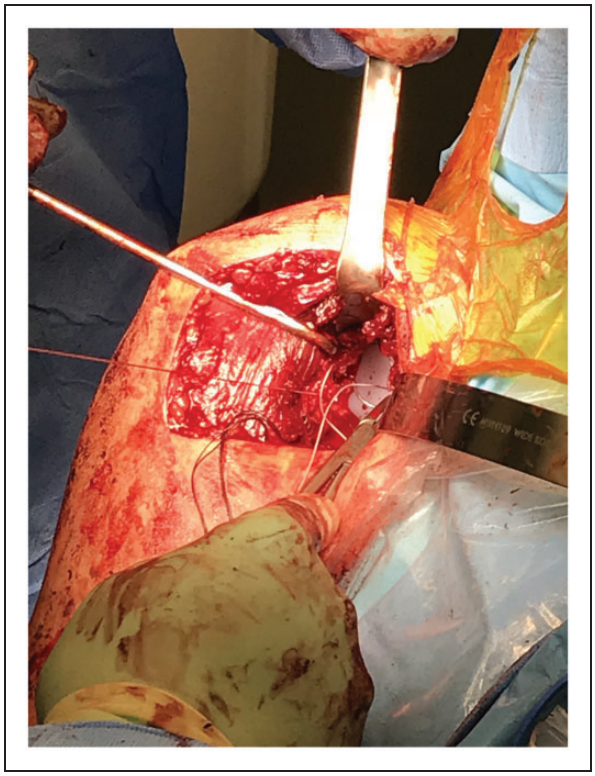

Figure 1. A #2 nonabsorbable suture is placed as a square purse-string stitch into the posterior capsule to tighten redundant tissue and increase posterior stability. One to 2 separate stitches can be placed as needed, based on intraoperative examination.

adhesions and as such we discuss with patients that there is always a small risk of this occurrence. Previous studies have shown that posterior glenoid erosion and posterior humeral head subluxation can be associated with worse outcomes after TSA and may be a factor involved in accelerated polyethylene wear, glenoid loosening, posterior TSA instability, and radiographic subluxation.[6,7,11–13] A majority of the patients in this study were classified as Walch type B glenoids preoperatively. The results of this study indicate that posterior capsule plication in the setting of intraoperative posterior subluxation and instability, despite appropriate component sizing, can be a successful without negatively affecting postoperative ROM.

There are limitations to this study. The number of patients involved in the study was only 17, and further studies involving a larger number of patients with complete pre- and postoperative imaging would be beneficial. Due to retrospective nature of collection of preoperative data, not all patients had adequate imaging available for review. While quantitative data as far as ROM pre- and immediately postoperatively was collected, we do not have additional patient-reported outcome data nor a control group for comparison of ROM. In addition, final evaluation of patients was conducted via telephone, so quantitative numbers on final ROM could not be provided for evaluation; however, the goal was to determine general patient satisfaction and if they had undergone additional procedures in the interim. Follow-up ranged from 8 months to 62 months which is short- to mid-term follow-up for shoulder arthroplasty. However, other studies have shown numerous dislocation and need for revisions with a mean follow-up of 30 months.[26]

Prior to this study, there was very little clinical outcome data regarding the use of posterior capsule plication as a tool to address residual posterior instability in TSA. This is a difficult problem to address and many available options have limitations and complications associated with their use. Eccentric reaming can maximally correct 15°, bone grafting has been associated with failure of graft incorporation, and reverse TSA has a higher complication rate and is generally recommended for older more sedentary patients. While reverse TSA has shown favorable outcomes for the treatment of glenohumeral arthritis with a biconcave glenoid,[23] the average age at the time of surgery for the patients in this study was 61 years and this may not be the best option for a younger patient population. In contrary to prior studies looking at posterior capsule plication, our study indicates that there is improved postoperative ROM and no evidence of recurrent posterior subluxation or instability after this procedure for the case series presented. Additional studies would be useful to compare pre- and postoperative ROM as well as patient-reported outcomes for those patients undergoing TSA with to a control group without need for capsular plication.

Conclusion

This study demonstrates that the use of posterior capsule plication during TSA is a safe method to address persistent posterior subluxation intraoperatively without significant risk for loss of motion or continued instability. Patients show improved ROM postoperatively and did not report any dislocation/subluxation events.

Declaration of Conflicting Interests

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