Outcomes After Bankart Repair in a Military Population: Predictors for Surgical Revision and Long-Term Disability

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Purpose: To quantify the rate of surgical failure after anterior shoulder stabilization procedures, as well as to identify demographic and surgical risk factors associated with poor outcomes. **Methods:** All Army patients undergoing arthroscopic or open Bankart repair for shoulder instability were isolated from the Military Health System Management Analysis and Reporting Tool between 2003 and 2010. Demographic variables (age, gender) and surgical variables (treatment facility volume, admission status, surgical technique) were extracted. Rates of surgical failure, defined as subsequent revision surgery or medical discharge with persistent shoulder complaints, were recorded from the electronic medical record and US Army Physical Disability Agency database. Risk factor analysis was performed with univariate *t* tests, χ^2 tests, and a multivariable logistic regression model with failure as the outcome. **Results:** A total of 3,854 patients underwent Bankart repair during the study period, with most procedures having been performed arthroscopically (n = 3,230, 84%) and on an outpatient basis (n = 3,255, 84%). Patients were predominately men (n = 3,531, 92%), and the mean age was 28.0 years (SD, 7.5 years). A total of 193 patients (5.0%) underwent revision stabilization whereas 339 patients (8.8%) were medically discharged with complaints of shoulder instability, for a total combined failure rate of 13.8% (n = 532). Univariate analyses showed no significant effect for gender; however, younger age, higher facility volume, open repair, and inpatient status were significant factors associated with subsequent surgical failure. Multivariable analyses confirmed that young age (odds ratio [OR], 0.93; 95% confidence interval [CI], 0.91 to 0.96; $P < .001$), open repair (OR, 0.52; 95% CI, 0.36 to 0.75; $P = .001$), and inpatient status (OR, 0.58; 95% CI, 0.40 to 0.84; $P = .004$) were independently associated with failure by revision surgery. **Conclusions:** Young age remains a significant risk factor for surgical failure after Bankart repair. Patients who underwent arthroscopic Bankart repair had a significantly lower surgical failure rate (4.5%) than patients who underwent open anterior stabilization (7.7%). Despite advances in surgical technique, 1 in 20 military service members required revision surgery after failed primary stabilization in this study. **Level of Evidence:** Level IV, therapeutic case series.

Shoulder instability is endemic in military populations, with a reported incidence rate an order of magnitude greater than that reported in civilian centers.[1,2] With advancements in surgical technique and a transition toward more arthroscopic stabilization procedures, orthopaedic surgeons have developed renewed interest in the rates of recurrent postoperative shoulder dislocations or other resultant shoulder disability in current clinical practice when compared with earlier, more invasive open procedures. In addition, few studies have attempted to systematically establish the risk factors associated with postoperative recurrence of shoulder instability or poor patient outcomes in a high-risk patient population.

The purpose of this study was to quantify the rate of surgical failure after anterior shoulder stabilization procedures, as well as to identify demographic and surgical risk factors associated with poor outcomes. We hypothesized that male gender, younger age, lower facility volume, and arthroscopic technique would be associated with worse postoperative outcomes.

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Methods

Military service members and other TRICARE beneficiaries receiving direct or purchased care through the Military Health System (MHS) are prospectively entered into the MHS Management Analysis and Reporting Tool (M2) database. In conjunction with the MHS Data Repository, the M2 database provides beneficiary data, demographic information, selected clinical data, and billing and coding information related to the use of medical and surgical services. Given its robust capabilities and access to over 9.5 million beneficiaries, this tool has previously been used to define specific cohorts within the Department of Defense for the purposes of clinical research.[3]

All patients undergoing arthroscopic or open Bankart repair of the shoulder (Current Procedural Terminology [CPT] code 29806 or 23455) for diagnoses related to shoulder instability (*International Classification of Diseases, Ninth Revision* [ICD-9] code 718.31, 718.81, and/or 831.00) at military treatment facilities and civilian centers were isolated from the M2 database between 2003 and 2010. Ambulatory outpatient procedures reference both CPT and ICD-9 codes for direct analysis, whereas inpatient procedures identify only ICD-9 coding and required secondary chart review. After this patient cohort was isolated from the M2, subsequent retrospective, independent, line-by-line electronic medical record review of clinical encounters and radiology reports from the Armed Forces Health Longitudinal Technology Application (AHLTA, version 3.6.0; 3M Health Information Systems, Salt Lake City, UT) was performed by 2 investigators to confirm the clinical diagnosis, as well as to identify primary and secondary surgical procedures, laterality, surgical history, subjective and objective clinical course, and initiation of a Physical Evaluation Board assessment because of persistent shoulder complaints. Demographic variables including age (collected as a continuous variable at the time of surgery), gender, and military rank were extracted, as were surgical variables including the treatment facility's volume of shoulder stabilization procedures (high [>250 cases per year], medium [125 to 250 cases per year], low [<125 cases per year], or civilian network referral), patient status (inpatient *v* outpatient), and type of surgical procedure (open *v* arthroscopic).

After an extensive review of charting from orthopaedic surgery, physical therapy, and radiology was performed, patients with documented predominately posterior labral tears or isolated posterior instability (e.g., positive posterior load-shift test, Kim test, jerk test, or magnetic resonance imaging),[4-6] multidirectional or bidirectional instability (e.g., sulcus sign, Gagey hyperabduction test, or positive apprehension test in multiple directions),[7,8] hyperlaxity conditions (e.g., Beighton criteria),[9] humeral avulsion of the glenohumeral ligament, significant attritional or traumatic glenohumeral bone loss (e.g., >25% of glenoid or engaging Hill-Sachs lesion), and/or bone augmentation procedures (CPT codes 23460 and 23462 [e.g., iliac crest augmentation or coracoid transfer—type procedures]) were excluded from further analysis. Rates of surgical failure were defined in this study as (1) subsequent ipsilateral revision stabilization surgery (e.g., surgical failure) and/or (2) medical discharge with persistent shoulder disability and supporting findings on physical examination as identified in the electronic medical record, M2 database, and/or US Army Physical Disability Agency database (e.g., clinical failure). For identified military service members undergoing Physical Evaluation Board assessment to determine fit-for-duty status, the US Army Physical Disability Agency database was cross-referenced to isolate only those patients who were declared unfit for duty and for whom military discharge was indicated because of significant postoperative shoulder disability.

Statistical Analysis

We calculated standard descriptive statistics including means and standard deviations for continuous variables and counts and frequencies for categorical variables. Initially, we evaluated the importance of factors associated with surgical failure using univariate *t* tests and χ^2 tests for continuous and categorical variables, respectively. Variables that were associated with failure were then carried forward into a multivariable logistic regression model with surgical failure as the outcome. For all analyses, $P < .05$ was deemed significant.

Results

Demographic Variables

A total of 3,854 Army patients underwent Bankart repair between 2003 and 2010. This cohort was composed predominately of men (n = 3,531, 92%), with women representing only 8% (n = 323). The mean age of the cohort was 28.0 years (SD, 7.5 years).

Surgical Variables

Of the procedures, 3,230 (84%) were performed arthroscopically and 624 (16%) were performed in an open manner. Most of these stabilizations were performed on an outpatient basis (n = 3,255, 84%), as compared with 599 patients (16%) who received inpatient care.

Surgical Failure

On evaluation, 193 patients (5.0%) required revision anterior shoulder stabilization (Table 1). In addition, 339 patients (8.8%) underwent medical discharge from the military for persistent complaints of shoulder instability. When both surgical revision and shoulder-related military discharge cases were combined, a total of 532 individual patients were identified as surgical

Table 1. Failure after Primary Anterior Stabilization

Variable	Total	Revision Surgery*	Shoulder-Related Disability*	Combined Failure*
Repair technique				
Open	624	48 (7.7%)	64 (10.3%)	112 (17.9%)
Arthroscopic	3,230	145 (4.5%)	275 (8.5%)	420 (13.0%)
Facility volume				
High	1,209	57 (4.7%)	102 (8.4%)	159 (13.2%)
Medium	1,002	47 (4.7%)	98 (9.8%)	145 (14.5%)
Low	818	53 (6.5%)	74 (9.0%)	127 (15.5%)
Hospital status				
Inpatient	599	44 (7.3%)	44 (7.3%)	88 (14.7%)
Outpatient	3,255	149 (4.6%)	295 (9.1%)	444 (13.6%)
Age				
<20 yr	234	14 (6.0%)	14 (6.0%)	28 (12.0%)
20-24 yr	1,377	100 (7.3%)	147 (10.7%)	247 (17.9%)
25-29 yr	952	50 (5.3%)	106 (11.1%)	156 (16.4%)
30-34 yr	505	18 (3.6%)	35 (6.9%)	53 (10.5%)
35-39 yr	427	8 (1.9%)	26 (6.1%)	34 (8.0%)
≥40 yr	359	3 (0.8%)	11 (3.1%)	14 (3.9%)

*The data are expressed as the raw number of patients (percentage of the total number of patients) in a given subcategory.

failures, resulting in a combined failure rate of 13.8% at 2 to 7 years' follow-up.

Risk Factors

Univariate analyses showed no significant effect for gender. However, younger age, higher facility volume, open repair, and inpatient status were significant factors associated with subsequent surgical failure (Table 2). Multivariable analyses controlling for these factors confirmed that all factors except facility volume were independently associated with failure by revision surgery (Table 3). Adjusted analyses showed that for every 1-year increase in age, there was a 7% decrease in the likelihood of failure (odds ratio [OR], 0.93; 95% confidence interval [CI], 0.91 to 0.96; $P < .001$). Furthermore, patients undergoing an arthroscopic repair were nearly 50% less likely to have a subsequent failure when compared with those treated with an open procedure (OR, 0.52; 95% CI, 0.36 to 0.75; $P = .001$). Finally, patients who underwent outpatient procedures were 41% less likely to have a subsequent failure when compared with those receiving inpatient care (OR, 0.58; 95% CI, 0.40 to 0.84; $P = .004$).

Table 2. Univariate Analyses for Surgical Failure After Bankart Repair

Variable	OR	95% CI	*P* Value
Gender*	1.13	0.69-1.86	.627
Age	0.93	0.90-0.95	<.001
Facility volume†			
Civilian	1.00		
High	1.88	1.18-2.99	.008
Medium	1.33	0.83-2.14	.232
Low	1.34	0.85-2.12	.207
Admission status	0.61	0.43-0.86	.005
Repair technique	0.56	0.40-0.79	.001

*The referent category was female gender.
†The referent category was civilian facilities contracted through insurance providers.

Table 3. Multivariable Logistic Regression Analysis for Surgical Failure

Variable	OR*	95% CI	*P* Value
Age	0.93	0.91-0.96	<.001
Facility volume†			
Civilian	1.00		
High	1.21	0.73-1.99	.457
Medium	0.97	0.59-1.57	.914
Low	0.98	0.61-1.59	.934
Admission status	0.58	0.40-0.84	.004
Repair technique	0.52	0.36-0.75	.001

*ORs were adjusted for all other covariates in the table.
†The referent category was civilian facilities contracted through insurance providers.

Discussion

In this study surgical failure after an anterior shoulder stabilization procedure, defined as the requirement for either revision surgery or medical discharge for persistent shoulder complaints, occurred in 13.8% of military service members undergoing surgery for shoulder instability at 2 to 7 years' follow-up. Furthermore, male gender, younger patient age, open repair, and inpatient status were identified as factors associated with subsequent surgical failure.

Although surgical failure after anterior shoulder stabilization is variably reported depending on surgical technique and the outcome of interest, open Bankart repair has long been considered the gold standard. Early redislocation rates after traditional arthroscopic Bankart repair were unacceptably high, particularly with recurrent instability, with rates upward of 49%.[10] However, with the refinement of surgical technique and broader acceptance of arthroscopic technique,[11] results after arthroscopic Bankart repair reported in the literature have been comparable with those of open repair.[12-18] In a recent systematic review of long-term surgical outcomes after anterior shoulder stabilization, Harris et al.[19] showed no difference in the rate of recurrent instability between arthroscopic (11%) and open (8%) surgical techniques at a mean of 9.1 and 13.1 years' follow-up, respectively. Owens et al.[11] reported that approximately 90% of all Bankart repairs reviewed by the American Board of Orthopaedic Surgery in 2008 were performed by arthroscopic technique when compared with under 60% in 2003. Similarly, rates of subsequent dislocation and rates of other postoperative complications were consistently higher with open procedures (1.2% and 9.4%, respectively) than with arthroscopic procedures (0.36%

and 3.9%, respectively) in this study. Though successful at preventing recurrent instability, open anterior reconstructions may also be accompanied by increased morbidity, longer operative times, greater blood loss, more restrictions in motion, and subscapularis insufficiency or failure.[15,20,21] In addition, open stabilization procedures are more commonly reserved for attritional bone loss with secondary bone block procedures or revision of failed arthroscopic Bankart repairs in current orthopaedic practice, although these patients were excluded in our study. As a result, the potential for confounding by surgical indication may also predispose more complex instability repairs toward surgical failure after open stabilization.

Male gender and young patient age are frequently highlighted as determinants of primary shoulder dislocation and subsequent recurrent dislocation,[22] even after surgical treatment.[23] Porcellini et al.[23] showed that male patients were significantly more likely to sustain redislocation after arthroscopic repair (10.1%) than their female counterparts (2.8%), with an adjusted OR of 3.65 associated with male gender. Similarly, they reported that patients aged younger than 22 years were more likely to sustain recurrent shoulder instability. In a separate study, Boileau et al.[24] evaluated the risk factors for recurrence after arthroscopic Bankart repair and failed to show any statistically significant differences by gender or age at the time of the first episode of instability. However, 13 of 15 patients with recurrent instability in their study were men.

Although treatment facility volume of shoulder stabilization procedures was initially associated with failure after Bankart repair, it failed to independently predict surgical failure after we controlled for the other variables in our statistical model. Multiple studies have underscored the role of surgical volume in predicting outcomes after various orthopaedic procedures, from knee arthroplasty[25] to intertrochanteric hip fracture.[26] Jain et al.[27] showed that patients treated by surgeons performing fewer than 2 to 4 shoulder arthroplasty procedures per year had a higher risk of death and perioperative complications than patients treated by their higher-volume counterparts. Similarly, hospitals with fewer than 10 total shoulder arthroplasties per year also had elevated rates of surgical complications. Hammond et al.[28] reported similar findings in their evaluation of patients undergoing shoulder arthroplasty, with patients of lower-volume surgeons having nearly twice as many complications as those treated by higher-volume surgeons. To date, no study has shown a definitive link between low surgical volume and treatment failure after anterior shoulder stabilization. Given the prevalence of shoulder instability in the military and the frequency of subsequent surgical procedures, the treatment facilities sampled in this study may represent higher-volume centers relative to other settings, and there may be a greater parity between higher- and lower-volume facilities in this study. However, we cannot discount the potential role of the individual surgeon's prior experience in clinical outcomes after Bankart repair because we were unable to assess for surgical failure as a function of individual provider volume in this investigation.

Hospital inpatient status was also associated with a significantly increased risk of surgical failure in this study. The potential for confounding by indication in this study may also be present in the evaluation of the association between surgical failure and postoperative hospitalization. Specifically, postoperative hospitalization in this study may be an indication of greater technical complexity, perioperative complications, or significant medical comorbidities. Similarly, lower surgical volume or limited surgeon experience may also be associated with prolonged hospital stay and greater health care utilization, particularly with complex shoulder surgery.[27,28] However, other potentially confounding variables must also be acknowledged. Junior enlisted service members and military cadets are more regularly admitted to the hospital for observation because of the lack of appropriate support in communal military housing. As a consequence, this may overrepresent a younger, more active high-risk cohort among those patients requiring hospital admission. Further research should more directly evaluate for the role of hospital admission in clinical outcomes after ambulatory shoulder surgery.

Limitations

The merits of this study include its large sample size; high-demand, physically active cohort; closed patient population; required periodic health assessments; and extensive electronic medical record review. However, certain limitations should also be mentioned. Surgical failure in this study was narrowly defined as the requirement for either revision anterior stabilization or medical discharge for continuing complaints related to the shoulder. However, other poor patient outcomes, including postoperative shoulder instability, may also constitute surgical failure but were not included in this investigation because of inconsistent documentation. As a result, the data may represent a more conservative estimate of surgical failure after Bankart repair and fail to account for patients with clinical failure not proceeding to revision surgery or military discharge. Furthermore, we cannot exclude those service members with secondary-gain motivations who may pursue medical discharge under the pretense of persistent shoulder instability or other functional complaints. Conversely, some service members may have persistent postoperative shoulder instability but their operational specialty or other motivating factors preclude their pursuit of medical discharge or clinical evaluation for revision surgery. In addition,

certain patient-specific factors (e.g., age at initial shoulder dislocation, cumulative number of dislocations, or duration of preoperative shoulder instability) and surgery-/surgeon-specific factors (e.g., decision-making algorithm, intraoperative surgical findings, posterior or superior labral involvement, surgical technique, surgical implant, number of suture anchors, or rehabilitation protocol) were unavailable and could not be evaluated or controlled for in our analysis. Similarly, given a lack of direct access to preoperative advanced imaging and operative reports, we cannot fully exclude occult bone loss as a contributing factor for postoperative failure after primary anterior shoulder stabilization. As the military moves toward a more robust and integrated multicenter orthopaedic registry, we will be able to better provide and control for various patient-specific and surgical variables not available in this study. In addition, this will allow access to validated patient-reported outcome measures in defining clinical success after shoulder stabilization surgery while offering more concrete and descriptive data about return to full duty among stratified high-risk cohorts within the military.

Conclusions

Young age remains a significant risk factor for surgical failure after Bankart repair. Patients who underwent arthroscopic Bankart repair had a significantly lower surgical failure rate (4.5%) than patients who underwent open anterior stabilization (7.7%). Despite advances in surgical technique, 1 in 20 military service members required revision surgery after failed primary stabilization in this study.

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