Trends in Surgical Management of Anterior Shoulder Instability: Increased Utilization of Bone Augmentation Techniques†

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ABSTRACT Purpose: The purpose of this study is to evaluate the trends in surgical management for anterior shoulder instability in the U.S. Military. Methods: A retrospective analysis of military service members undergoing arthroscopic or open shoulder stabilization from 2012 to 2015 within the U.S. Military Health System was conducted. Demographic and surgical variables were extracted from the medical record. Chi-square and linear regression analysis were performed to identify temporal trends by surgical procedures and concomitant surgery. Associations between demographic variables and surgical procedure were evaluated using logistic regression analysis with odds ratios and 95% confidence intervals. Results: Eight thousand five hundred and eighty nine surgeries were performed for anterior shoulder instability. The arthroscopic Bankart procedure remained the dominant surgical procedure over time (n = 8177, 95.2%), whereas the open Bankart procedure (n = 172, 2.0%) demonstrated a diminishing trend, which was significant on univariate analysis (p = 0.0009), but not statistically significant on linear regression (p = 0.12). Additionally, there was a significant trend toward increased utilization of the Latarjet procedure over the period studied (n = 33, 1.7% – n = 81, 3.56%) (p = 0.009). During the same time period, concomitant superior labrum anterior/posterior repairs decreased (n = 980, 11.4%; p = 0.0045), whereas rates of biceps tenodesis (n = 741, 8.6%; p = 0.05) increased significantly. When analyzing patient age as a continuous variable, increasing age was associated with a significantly higher likelihood of arthroscopic treatment (odds ratio 1.02, 95% confidence interval 1.00–1.03, p = 0.05). Conclusion: The rate of performing an arthroscopic Bankart repair has remained relatively stable as the dominant surgical procedure for shoulder instability in the military patient population. There was a significant trend of increased use of the Latarjet procedure, which likely reflects the recognition of bone loss through use of preoperative advanced imaging and computed tomography with three-dimensional reconstructions. Additionally, there was a significant decrease in adjacent superior labrum anterior/posterior repairs over the study period, followed by a corresponding rise in biceps tenodesis. Level of evidence: level IV.

INTRODUCTION

The incidence of shoulder instability among U.S. Military personnel (1.69 per 1,000 person-years) is considerably higher than the general U.S. population (0.08 per 1,000 person-years).[1,2] Young male military athletes have an incidence of anterior shoulder instability at an order of magnitude greater than the civilian population, with rates as high as 3% per year.[2] Historically, open Bankart repair was considered the gold standard for surgical management of these injuries with excellent outcomes.[3,4] However, numerous studies demonstrate comparable results and low rates of recurrence with modern arthroscopic techniques.[5,6] More recently, identification of risk factors for failure of a primary capsulolabral repair, such as "critical" and "subcritical" anterior inferior bone loss and "off track" Hill Sachs lesions combined with glenoid bone loss, are transforming established treatment algorithms, while refining indications for bone-grafting procedures to minimize recurrent instability.[7–10] Furthermore, the advent and wider availability of three-dimensional computed tomography (CT) reconstruction sequences to better understand glenoid morphology and bone loss have assisted clinicians in determining when a soft tissue repair is indicated versus a bony augmentation surgery. Although the understanding of risk factors for failure of an arthroscopic Bankart has improved, it is unknown to what extent the improved understanding and recognition of bone loss has had on surgical decision-making regarding treatment.

The purpose of this study is to retrospectively review the epidemiology of surgical management of symptomatic anterior shoulder instability in active duty military service members. Additionally, we sought to use this ideal large cohort of predominantly young males to identify trends in surgical management of anterior shoulder instability. We hypothesized that there would be a trend toward more arthroscopic procedures with a corresponding decrease in the incidence of

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†The study is an Institutional Review Board approved study to evaluate the epidemiology of surgical treatment of anterior shoulder instability treatment.

doi: 10.1093/milmed/usx077

primary open Bankart repairs, as well as increased utilization of anterior bone block augmentation procedures.

METHODS

With institutional review board approval, a retrospective review was performed to identify all active duty military service members undergoing surgical treatment of anterior shoulder instability (International Classification of Disease, Ninth Edition [ICD-9] code 718.31, 718.81, or 831.00) within the Military Health System between 2012 and 2015. Specific coded procedures were extracted from the Military Health System Management Analysis and Reporting Tool (M2), including arthroscopic Bankart repair (Current Procedural Terminology [CPT] code 29806), open Bankart repair (CPT 23455), isolated anterior capsulorrhaphy with coracoid process transfer (CPT 23662), or anterior bone block augmentation (CPT 23460). Concomitant surgical procedures were also recorded.

The U.S. Department of Defense military electronic health record (Armed Forces Health Longitudinal Technology Application [AHLTA, version 3.3]) was queried for each individual service member previously identified to confirm the accuracy of procedural coding and to extract selected demographic variables, including age, sex, and branch of military service. The age categories used were <20, 20–29, 30–39, 40–49, and ≥50 yr of age, whereas military service categories used were Army, Navy, Air Force, and Marines.

Statistical Analysis

Statistical analysis was performed using SAS Software (version 9.4; SAS Institute, Inc., Cary, NC). Chi-square and linear regression analyses were performed to identify temporal trends by surgical procedures and concomitant surgery. Furthermore, the impact of demographic variables on the type of stabilization procedure was evaluated using logistic regression analysis, with a p-value of less than 0.05 deemed statistically significant.

RESULTS

Procedure Type

Over the 4-yr study period between 2012 and 2015, a total of 8,589 anterior stabilization procedures were performed for anterior glenohumeral instability, including 8,177 arthroscopic Bankart repairs (95.2%, Fig. 1), 172 open Bankart repairs and/or capsular shifts (2.0%), 231 Latarjet coracoid transfer procedures (2.69%, Fig. 2), and other anterior bone block stabilization procedures (e.g., fresh distal tibial allograft, autograft, or allograft tricortical iliac crest; 0.27%). Although the arthroscopic Bankart repair ($p = 0.84$), open Bankart ($p = 0.12$), and other anterior bone block procedures ($p = 0.46$) demonstrated stable trends over time, the Latarjet procedure continued to demonstrate increasing use ($p = 0.009$) in the current system (Table I). Additionally, it is important to note that there was a trend toward decreased utilization of the open Bankart procedure over the period studied ($n = 55$, 2.9% – $n = 36$, 1.6%); however, these results did not reach statistical significance on linear regression analysis ($p = 0.12$).

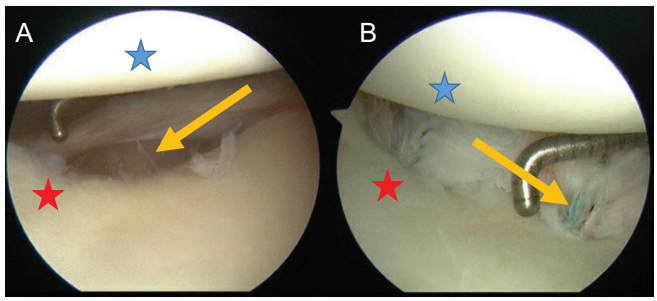

FIGURE 1. Intraoperative arthroscopic images of a Bankart repair procedure. (A) Image before the repair showing the humeral head (blue star), the Bankart tear in the labrum (yellow arrow), and the glenoid rim (red star). (B) Image after the repair showing the humeral head (blue star), the sutures through the labrum (yellow arrow), and the glenoid rim (red star).

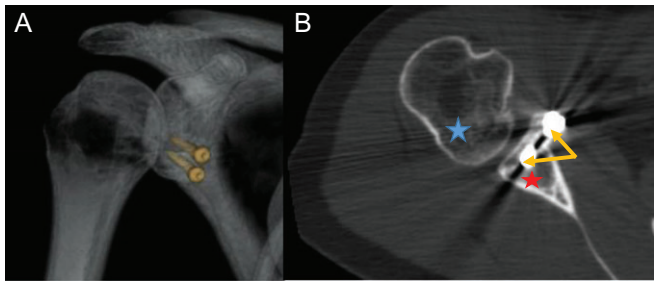

FIGURE 2. (A) Radiograph with visualization of Latarjet compression screws fixing the coracoid graft to the anterior glenoid. (B) CT scan, coronal view, showing a postoperative image after a Latarjet procedure with the humeral head (blue star), the compression screws (yellow arrows), and the glenoid (red star).

Associated Procedures

A total of 3,246 associated procedures were performed at the time of index stabilization (Table II), with superior labrum anterior/posterior (SLAP) repair ($n = 980$, 11.4%), subacromial decompression ($n = 709$, 8.3%), and biceps tenodesis ($n = 741$, 8.6%, Fig. 3) listed as the most common procedures. During the study period, there was a significant decrease in rates of adjacent arthroscopic SLAP repair ($p = 0.0045$) with a concordant increase in biceps tenodesis ($p = 0.05$).

Demographic Variables

Demographic analysis of the current patient series is listed in Table III. Consistent with the composition of the U.S. Armed Forces, males comprised 92.3% of all service members treated in this study. Furthermore, 68.4% of patients with symptomatic anterior shoulder instability were under the age of 30 yr. When analyzing patient age as a continuous variable, increasing chronologic patient age was associated with a significantly higher likelihood of arthroscopic treatment (odds ratio [OR] 1.02, 95% confidence interval [CI] 1.00–1.03, $p = 0.05$).

TABLE I. Surgical Procedures Performed from 2012 to 2015 Within the U.S. Military Health System for Anterior Shoulder Instability

	2012 (%)	2013 (%)	2014 (%)	2015 (%)	Total	Percent Overall	*p*-Value for Chi-Square Test	*p*-Value with Linear Regression Analysis
CPT 29806: arthroscopic Bankart repair	1,825 (95.2)	2,070 (95.0)	2,132 (95.8)	2,150 (94.8)	8,177	95.2	0.3953	(−0.05 ± 0.24), 0.8446
CPT 23455: open Bankart repair	55 (2.9)	52 (2.4)	29 (1.3)	36 (1.6)	172	2.0	<0.001	(−0.49 ± 0.19), 0.1178
CPT 23462: isolated anterior capsulorrhaphy with coracoid process transfer	33 (1.7)	54 (2.5)	63 (2.8)	81 (3.6)	231	2.7	0.0027	(0.59 ± 0.06), 0.0091
CPT 23460: anterior bone block augmentation	8 (0.4)	4 (0.2)	5 (0.2)	6 (0.3)	23	0.3	0.5053	(−0.04 ± 0.05), 0.4600
Total number of cases	1,917	2,178	2,225	2,269	8,589			

TABLE II. Associated Procedures Performed from 2012 to 2015 for Those Undergoing Surgical Management for Anterior Shoulder Instability.

Concomitant Diagnosis or Procedure	Frequency (%)	*p*-Value for Chi-Square Test	*p*-Value with Linear Regression Analysis
ICD-9 831.02: closed posterior dislocation of the shoulder	25 (0.29)	0.54	0.0983 (−0.07 ± 0.02)
CPT code 29807: arthroscopy, surgical; repair of a SLAP lesion	980 (11.41)	<0.0001	0.0045 (−1.50 ± 0.10)
CPT code 23430: biceps tenodesis	741 (8.63)	<0.0001	0.0530 (2.73 ± 0.66)
CPT code 23412, 23410, 29827: rotator cuff repair	183 (2.13)	0.57	0.2826 (0.15 ± 0.10)
CPT code 23552, 23550: AC and/or CC ligament repair/reconstruction	18 (0.21)	0.37	0.3207 (0.05 ± 0.04)
CPT code 23120, 29824: Mumford procedure or distal clavicle excision	586 (6.82)	0.94	0.9606 (0.01 ± 0.11)
CPT code 29826, 23130: subacromial decompression	709 (8.25)	<0.0001	0.1872 (−1.08 ± 0.55)
CPT code 23466: capsulorrhaphy, glenohumeral joint, any type multi-directional instability	4 (0.05)	0.62	0.4413 (0.02 ± 0.02)

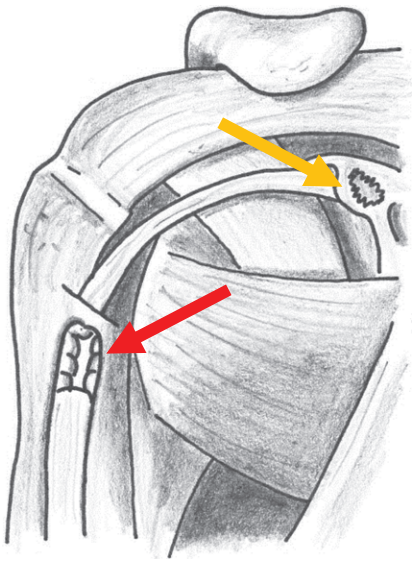

FIGURE 3. Composite image demonstrating both a SLAP tear (yellow arrow) and biceps tenodesis (red arrow).

DISCUSSION

The results of this study indicate that the arthroscopic Bankart repair remains the primary surgical procedure in approximately 95% of all cases of military service members undergoing anterior shoulder stabilization. Over the period studied, there was a significant trend toward increased bone augmentation surgery and a trend toward decreased utilization of the traditional open Bankart procedure, which did not reach statistical significance. In associated procedures, there was significant trend toward increased biceps tenodesis procedures with a decline in adjacent SLAP repairs.

Symptomatic anterior shoulder instability is a common source of dysfunction in young athletic individuals, especially in the military setting.[1,2] Arthroscopic capsulolabral repair for the first-time dislocator and for patients with recurrent anterior shoulder instability has shown to be successful.[11–14] More recently, "critical" and "subcritical" glenoid anteroinferior bone loss, "off track" Hill Sachs lesions, contact and overhead athletes, and inferior shoulder hyperlaxity are variables that have been identified as risk factors associated with failure after a primary Bankart repair.[7–10] Glenoid bone augmentation procedures such as the Latarjet are becoming increasingly utilized in at-risk shoulder instability populations. Recent evidence has shown moderate short-term outcomes in high-risk military athletes.[10]

Recently, reports of bony augmentation procedures such as the Latarjet for management of recurrent anterior shoulder instability have shown favorable results. Bessiere et al retrospectively compared 93 patients who underwent arthroscopic Bankart versus 93 patients after the Latarjet procedure.[15] At a mean of 6-yr follow-up, 10% of Latarjet patients and 22% of arthroscopic Bankart repairs had recurrent instability, and the Latarjet group, on average, demonstrated higher Rowe

TABLE III. Demographic Breakdown of the Study Cohort.

	Total *n* (%)	CPT 29806: Arthroscopic Bankart Repair *n* (%)	CPT 29806: Arthroscopic Bankart Repair OR (95% CI), *p*-Value	CPT 23455: Open Bankart Repair *n* (%)	CPT 23455: Open Bankart Repair OR (95% CI), *p*-Value	CPT 23462: Isolated Anterior Capsulorrhaphy with Coracoid Process Transfer *n* (%)	CPT 23462: Isolated Anterior Capsulorrhaphy with Coracoid Process Transfer OR (95% CI), *p*-Value	CPT 23460: Anterior Bone Block Augmentation *n* (%)	CPT 23460: Anterior Bone Block Augmentation OR (95% CI), *p*-Value
Gender									
Male	7,926 (92.3)	7,544 (92.3)	0.94 (0.64–1.37), 0.7331	154 (89.5)	0.71 (0.43–1.17), 0.1749	219 (94.8)	1.54 (0.86–2.77), 0.1481	22 (95.7)	1.84 (0.25–13.69), 0.5503
Female	663 (7.7)	633 (7.7)	Referent[a]	18 (10.5)	Referent	12 (5.2)	Referent	1 (4.3)	Referent
Total *n*	8,589	8,177		172		231		23	
Age			1.02 (1.00–1.03), 0.0525		0.98 (0.96–1.01), 0.1026		1.02 (0.99–1.04), 0.1123		0.99 (0.94–1.06), 0.8460
<20	411 (4.8)	391 (4.8)	Referent	6 (3.5)	Referent	14 (6.1)	Referent	0 (0)	Referent
20–29	5,461 (63.6)	5,192 (63.5)	1.01 (0.64–1.60), 0.9700	120 (69.8)	1.41 (0.64-3.12), 0.4005	146 (63.2)	0.76 (0.44–1.31), 0.3176	15 (65.2)	2.34 (0.14–39.34), 0.5544
30–39	2,108 (24.5)	2,002 (24.5)	0.99 (0.61–1.60), 0.9499	41 (23.8)	1.25 (0.54–2.89), 0.5973	59 (25.5)	0.80 (0.44–1.43), 0.4440	8 (34.8)	3.33 (0.19–58.01), 0.4092
40–49	562 (6.5)	545 (6.7)	1.63 (0.85–3.13), 0.1406	5 (2.9)	0.62 (0.20–1.93), 0.4057	12 (5.2)	0.62 (0.29–1.34), 0.2265	0 (0)	0.73 (0.01–37.10), 0.8760
50+	47 (0.6)	47 (0.6)	4.98 (0.29–86.10), 0.2700	0 (0)	0.66 (0.04–12.19), 0.7777	0 (0)	0.29 (0.02–5.06), 0.3951	0 (0)	8.66 (0.17–452.06), 0.2846
Total *n*	8,589	8,177		172		231		23	
Branch of service									
Army	4,172 (48.7)	3,978 (48.8)	0.91 (0.69–1.19), 0.4889	74 (43.3)	1.03 (0.67–1.57), 0.9082	118 (51.1)	1.24 (0.87–1.78), 0.2370	8 (34.8)	0.57 (0.20–1.65), 0.3010
Air Force	940 (11.0)	880 (10.8)	0.65 (0.45–0.91), 0.0153	26 (15.2)	1.62 (0.95–2.74), 0.0748	35 (15.2)	1.65 (1.04–2.61), 0.0320	4 (17.4)	1.27 (0.36–4.52), 0.7104
Navy	1,663 (19.4)	1,582 (19.4)	0.87 (0.63–1.19), 0.3769	40 (23.4)	1.40 (0.87–2.25), 0.1647	37 (16.0)	0.97 (0.62–1.52), 0.8988	5 (21.7)	0.90 (0.27–2.95), 0.8580
Marines	1,791 (20.9)	1,715 (21.0)	Referent	31 (18.1)	Referent	41 (17.8)	Referent	6 (26.1)	Referent
Total *n*	8,566	8,155		171		231		23	

[a]Referent: Comparison group upon which OR are based (indicates a relative risk of 1.0).

Scores, 78 versus 68. Shoulder hyperlaxity and involvement in competitive sports were significantly associated with failure in the Bankart group. Zimmerman et al showed similar results with 11% recurrent instability compared with 41.7% in the arthroscopic Bankart and Latarjet groups, respectively.[16] Additionally, a recent systematic review and meta-analysis of eight studies reported a significantly lower risk of recurrence and redislocation in the outcomes of open Latarjet procedures relative to those of arthroscopic Bankart repairs.[17] Despite the increased risks to neurovascular structures,[18] risk of late development of shoulder arthritis,[19] and the need for an open nonanatomical procedure, the open Latarjet has become a successful alternative to the arthroscopic Bankart repair for at-risk shoulder instability populations. In contrast, evidence exists to support the long-term reliability of the arthroscopic Bankart repair in young athletes. Aboalata et al reported an 18.1% failure rate after an arthroscopic Bankart at a mean of 13-yr follow-up.[6] In a military population, Waterman et al reviewed 3,854 patients who underwent Bankart repair, 84% of which were arthroscopic procedures. The failure rate in this cohort was 13.8%, with 5% of all patients undergoing a revision surgery. Younger age and open repair were significantly associated with surgical failure.[20] Therefore, the evidence supports that the arthroscopic Bankart repair is still an effective procedure for the young active patient with minimal to no bone loss. Our data confirm this trend in the military population. Moreover, a compilation of recent evidence showing good mid-term outcomes with low rates of recurrence after the Latarjet in young athletes has likely contributed to the trend of increased open bony augmentation procedures in the military from 2012 to 2015.

The importance of preoperative recognition of "subcritical" and critical bone loss is another variable to explain the trends in management of anterior shoulder instability in the military. Itoi's landmark article changed the management of anterior shoulder instability when he defined 21% as the critical bone loss, which may cause failure after a primary Bankart repair.[21] A more recent study defined 13.5% as a "subcritical" amount of bone loss in an at-risk military shoulder instability population.[9] This evidence led to increased focus on accurate estimation of anteroinferior bone loss in shoulder instability populations. Three-dimensional CT scan became an effective tool to preoperatively measure percentage of bone loss.[22] Advanced imaging modalities such as three-dimensional CT scan have allowed better recognition of attritional bone loss, which has likely led to the increased use of bony augmentation procedures in the U.S. Military over the period studied.

Additionally, our results demonstrated that fewer concomitant SLAP repairs were performed over the period studied with a significant increase in biceps tenodesis procedures. This trend may be driven by recent research on high rates of failure for isolated SLAP repairs in the military population. A 2013 study by Provencher et al prospectively enrolled 179 patients undergoing type II SLAP repair at one military treatment facility. Thirty-seven percent of patients had failure with a 28% revision rate.[23] These results resonated throughout the military and likely changed the trends in management. Shortly thereafter, McCormick et al reported on the same cohort of military patients, and the authors evaluated the outcomes of biceps tenodesis after failed type II SLAP repair in 42 patients.[24] Eighty-one percent of patients returned to duty and there was a clinically significant improvement in outcome scores, range of motion and function. More recently, Waterman et al evaluated the minimum 2-yr outcomes of 192 active duty patients who underwent SLAP repair and also found that isolated repair of unstable SLAP lesions and/or increased upper extremity demands is associated with higher failure rates in this population.[25]

There are several limitations of this study. First, we are unable to control for other confounding variables such as systemic hyperlaxity, chronicity, number of instability events, bone loss, Hill Sachs lesions, and activity levels. Additionally, our retrospective review does not provide information regarding clinical outcomes, complication profiles, or recurrence rates and/or functional military endpoints with each respective procedure, particularly to correlate outcomes between open and arthroscopic procedures. It should be noted that because CPT coding of procedures in military facilities is often performed by coders, there is potential for inaccuracy in the procedure coding obtained from the military electronic medical record database (AHLTA). Also, procedures were performed at multiple medical centers by many surgical providers, and therefore, there were no preset diagnostic criteria or ability to retrospectively evaluate diagnoses with radiographs or advanced imaging modalities. Furthermore, medical decision-making may reflect surgeon's treatment bias regarding the ideal primary and revision procedures in a high-risk patient population. We theorize that the insignificant trend toward decreased use of the open Bankart procedure may be a by-product of training bias or inadequate exposure during residency or fellowship. Lastly, there are limitations inherent to any retrospective review such as incomplete reporting. However, it should be noted that there were only 16 patients without sex or age information and only 44 patients without a branch of service available in our data review. Therefore, it is unlikely that these small numbers had a significant impact on our results.

CONCLUSIONS

The contemporary rate of performing an arthroscopic Bankart repair has remained relatively stable as the dominant surgical procedure used for shoulder instability in the military patient population. Furthermore, there was a significant trend of increased use of the Latarjet procedure, which likely reflects the recognition of bone loss through use of preoperative advanced imaging and CT with three-dimensional reconstructions. Additionally, there was a significant decrease in

adjacent SLAP repairs over the study period, followed by a corresponding rise in biceps tenodesis.

REFERENCES

1. Owens BD, Dawson L, Burks R, Cameron KL: Incidence of shoulder dislocation in the United States military: demographic considerations from a high-risk population. J Bone Joint Surg Am 2009; 91(4): 791–6.
2. Waterman B, Owens BD, Tokish JM: Anterior shoulder instability in the military athlete. Sports Health 2016; 8(6): 514–9. pii: 1941738116672161. [Epub ahead of print].
3. Cole BJ, L'Insalata J, Irrgang J, Warner JJ: Comparison of arthroscopic and open anterior shoulder stabilization. A two to six-year follow-up study. J Bone Joint Surg Am 2000; 82-A(8): 1108–14.
4. Moroder P, Odorizzi M, Pizzinini S, Demetz E, Resch H, Moroder P: Open Bankart repair for the treatment of anterior shoulder instability without substantial osseous glenoid defects: results after a minimum follow-up of twenty years. J Bone Joint Surg Am 2015; 97(17): 1398–405.
5. Petrera M, Patella V, Patella S, Theodoropoulos J: A meta-analysis of open versus arthroscopic Bankart repair using suture anchors. Knee Surg Sports Traumatol Arthrosc 2010 Dec; 18(12): 1742–7.
6. Aboalata M, Plath JE, Seppel G, Juretzko J, Vogt S, Imhoff AB: Results of arthroscopic Bankart repair for anterior–nferior shoulder instability at 13-year follow-up. Am J Sports Med 2017; 45(4): 782–7. pii: 0363546516675145. [Epub ahead of print].
7. Boileau P, Villalba M, Héry JY, Balg F, Ahrens P, Neyton L: Risk factors for recurrence of shoulder instability after arthroscopic Bankart repair. J Bone Joint Surg Am 2006; 88(8): 1755–63.
8. Shaha JS, Cook JB, Rowles DJ, Bottoni CR, Shaha SH, Tokish JM: Clinical validation of the glenoid track concept in anterior glenohumeral instability. J Bone Joint Surg Am 2016; 98(22): 1918–23.
9. Shaha JS, Cook JB, Song DJ, et al: Redefining "critical" bone loss in shoulder instability: functional outcomes worsen with "subcritical" bone loss. Am J Sports Med 2015; 43(7): 1719–25.
10. Waterman BR, Chandler PJ, Teague E, Provencher MT, Tokish JM, Pallis MP: Short-term outcomes of glenoid bone block augmentation for complex anterior shoulder instability in a high-risk population. Arthroscopy 2016; 32(9): 1784–90.
11. Arciero RA, Wheeler JH, Ryan JB, et al: Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. Am J Sports Med 1994; 22: 589–94.
12. Arciero RA, Taylor DC, Snyder RJ, et al: Arthroscopic bioabsorbable tack stabilization of initial anterior shoulder dislocations: a preliminary report. Arthroscopy 1995; 11: 410–7.
13. Bottoni CR, Wilckens JH, DeBerardino TM, et al: A prospective, randomized evaluation of arthroscopic stabilization versus nonoperative treatment in patients with acute, traumatic, first-time shoulder dislocations. Am J Sports Med 2002; 30(4): 576–80.
14. Owens BD, DeBerardino TM, Nelson BJ, et al: Long-term follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocations in young athletes. Am J Sports Med 2009; 37(4): 669–73.
15. Bessière C, Trojani C, Carles M, Mehta SS, Boileau P: The open Latarjet procedure is more reliable in terms of shoulder stability than arthroscopic bankart repair. Clin Orthop Relat Res 2014; 472(8): 2345–51.
16. Zimmermann SM, Scheyerer MJ, Farshad M, Catanzaro S, Rahm S, Gerber C: Long-term restoration of anterior shoulder stability: a retrospective analysis of arthroscopic Bankart repair versus open Latarjet procedure. J Bone Joint Surg Am 2016; 98(23): 1954–61.
17. An VV, Sivakumar BS, Phan K, Trantalis J: A systematic review and meta-analysis of clinical and patient-reported outcomes following two procedures for recurrent traumatic anterior instability of the shoulder: Latarjet procedure vs. Bankart repair. J Shoulder Elbow Surg 2016; 25(5): 853–63.
18. Delaney RA, Freehill MT, Janfaza DR, Vlassakov KV, Higgins LD, Warner JJ: Neer Award Paper: neuromonitoring the Latarjet procedure. J Shoulder Elbow Surg 2014; 23(10): 1473–80.
19. Mizuno N, Denard PJ, Raiss P, Melis B, Walch G: Long-term results of the Latarjet procedure for anterior instability of the shoulder. See comment in PubMed Commons below. J Shoulder Elbow Surg 2014; 23 (11): 1691–9.
20. Waterman BR, Burns TC, McCriskin B, Kilcoyne K, Cameron KL, Owens BD: Outcomes after bankart repair in a military population: predictors for surgical revision and long-term disability. Arthroscopy 2014; 30(2): 172–7.
21. Itoi E, Lee SB, Berglund LJ, Berge LL, An KN: The effect of a glenoid defect on anteroinferior stability of the shoulder after Bankart repair: a cadaveric study. J Bone Joint Surg Am 2000; 82(1): 35–46.
22. Bishop JY, Jones GL, Rerko MA, Donaldson C, MOON Shoulder Group: 3-D CT is the most reliable imaging modality when quantifying glenoid bone loss. Clin Orthop Relat Res 2013; 471(4): 1251–6.
23. Provencher MT, McCormick F, Dewing C, McIntire S, Solomon D: A prospective analysis of 179 type 2 superior labrum anterior and posterior repairs: outcomes and factors associated with success and failure. Am J Sports Med 2013; 41(4): 880–6.
24. McCormick F, Nwachukwu BU, Solomon D, et al: The efficacy of biceps tenodesis in the treatment of failed superior labral anterior posterior repairs. Am J Sports Med 2014; 42(4): 820–5.
25. Waterman BR, Arroyo W, Heida K, Burks R, Pallis M: SLAP repairs with combined procedures have lower failure rate than isolated repairs in a military population: surgical outcomes with minimum 2-year follow-up. Orthop J Sports Med 2015; 3(8): 2325967115599154.