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Open shoulder stabilization: current trends and 1-year postoperative complications



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Background: Shoulder instability is commonly treated by arthroscopic stabilization. However, open stabilization procedures remain important in management of complex instability. Despite continued use of these procedures, the relative frequency of related complications remains poorly described. This study investigates current trends in open shoulder stabilization and characterizes major postoperative complications.

Methods: PearlDiver, a national insurance database of orthopedic patients, was used to identify open shoulder stabilization procedures from 2007 to 2010. *Current Procedural Terminology* codes for 4 procedures—Bankart repair, coracoid transfer, and anterior and posterior glenoid bone grafting—were used to track procedural trends. The 1-year postoperative complications were identified and categorized into 5 groups: dislocation treated with closed reduction, closed manipulation under anesthesia, reoperation with arthroscopy, reoperation with open surgery, and others. χ^2 analysis determined statistical significance.

Results: There were 2678 open shoulder stabilization procedures performed, with a 1-year complication rate of 12.3%. Relative proportion of open Bankart repairs decreased (82.5% to 69.8%), whereas proportion of coracoid transfers increased (7.7% to 19%). Posterior glenoid bone grafting had the highest complication rate (20.7%). Rate of total complications was 9.8% in patients 10–24 years, 13.6% in patients 25–54 years, and 25.9% in patients >55 years.

Conclusions: Based on our patient database sample, a significant decline in the relative use of open Bankart repair was observed. Our analysis indicates that the use of bone transfer procedures was correlated with significantly higher reoperation rates than open Bankart repair, particularly in the older patient cohort. Further studies comparing open stabilization procedures with contemporary arthroscopic techniques are indicated.

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Shoulder instability is a common^{19,22,39} and challenging orthopedic problem spanning an extensive patient demographic with an estimated incidence of 23.9 per 100,000.⁴⁸ Recurrent dislocation, apprehension, shoulder pain, and inability to participate in athletic activities are the most common symptoms,^{14,26,28} with glenohumeral arthrosis a potential long-term sequela. After first-time anterior dislocation, conservative management is typically

recommended. Recurrence rates range between 17% and 96%, with younger patients having higher risk.^{11,39,43} However, there is still debate about the indications for initial surgical management of primary dislocations. For young patients who regularly take part in physically demanding athletic pursuits, initial surgical management has been shown to be beneficial.^{7,8,10,13,18,21,24,38} A systematic review by Longo et al²⁸ reported a significantly lower recurrence rate after surgical management (9.6%) compared with conservative management (37.5%) of primary anterior shoulder dislocations.

The indication for surgical management in the case of recurrent shoulder instability is much less controversial, with a strong indication for surgical intervention.^{28,36,45} Furthermore, in the case of significant glenoid bone defects, surgical treatment with soft tissue stabilization alone is generally not sufficient.^{5,9} The integrity of the

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Table I
Current Procedural Terminology (CPT) codes included in each of the 5 complication groups

Complication group	CPT code and definition
Dislocation—closed treatment	<ul style="list-style-type: none"> • 23650 - Closed treatment of shoulder dislocation, with manipulation; without anesthesia • 23655 - Closed treatment of shoulder dislocation, with manipulation; requiring anesthesia
Closed adhesion release	<ul style="list-style-type: none"> • 23700 - Manipulation under anesthesia, shoulder joint, including application of fixation apparatus (dislocation excluded)
Reoperation—arthroscopy	<ul style="list-style-type: none"> • 23020 - Capsular contracture release (eg, Sever type procedure) • 29805 - Arthroscopy, shoulder, diagnostic, with or without synovial biopsy (separate procedure) • 29806 - Arthroscopy, shoulder, surgical; capsulorrhaphy • 29807 - Arthroscopy, shoulder, surgical; repair of SLAP lesion • 29819 - Arthroscopy, shoulder, surgical; with removal of loose body or foreign body • 29820 - Arthroscopy, shoulder, surgical; synovectomy, partial • 29821 - Arthroscopy, shoulder, surgical; synovectomy, complete • 29822 - Arthroscopy, shoulder, surgical; débridement, limited • 29823 - Arthroscopy, shoulder, surgical; débridement, extensive • 29824 - Arthroscopy, shoulder, surgical; distal claviclectomy including distal articular surface (Mumford procedure) • 29825 - Arthroscopy, shoulder, surgical; with lysis and resection of adhesions, with or without manipulation • 29826 - Arthroscopy, shoulder, surgical; decompression of subacromial space with partial acromioplasty, with or without coracoacromial release • 29827 - Arthroscopy, shoulder, surgical; with rotator cuff repair
Reoperation—open surgery	<ul style="list-style-type: none"> • 23450 - Capsulorrhaphy, anterior; Putti-Platt procedure or Magnuson type operation • 23455 - Capsulorrhaphy, anterior; with labral repair (eg, Bankart procedure) • 23460 - Capsulorrhaphy, anterior, any type; with bone block • 23462 - Capsulorrhaphy, anterior, any type; with coracoid process transfer • 23465 - Capsulorrhaphy, glenohumeral joint, posterior, with or without bone block • 23466 - Capsulorrhaphy, glenohumeral joint, any type multidirectional instability • 23107 - Arthrotomy, glenohumeral joint, with joint exploration, with or without removal of loose or foreign body • 23331 - Removal of foreign body, shoulder; deep (eg, Neer hemiarthroplasty removal) • 23660 - Open treatment of acute shoulder dislocation • 23670 - Open treatment of shoulder dislocation, with fracture of greater humeral tuberosity, with or without internal or external fixation
Other	<ul style="list-style-type: none"> • 23470 - Arthroplasty, glenohumeral joint; hemiarthroplasty • 23472 - Arthroplasty, glenohumeral joint; total shoulder (glenoid and proximal humeral replacement (eg, total shoulder)) • 23030 - Incision and drainage, shoulder area; deep abscess or hematoma

glenoid's osseous architecture has been identified as key in the success of surgical repair.^{9,23,31,35,40} This has led to increased interest in open autograft and allograft bone grafting procedures to address osseous glenoid deficiency. Despite their frequent use, the incidence of and complications after open bone transfer stabilization procedures are unknown.

Our study's purpose was 2-fold. The first aim was to investigate the current practice trends of 4 open shoulder stabilization procedures (open Bankart repair, coracoid process transfer, anterior glenoid bone grafting, and posterior glenoid bone grafting) during a 4-year period from 2007 to 2010. Our second aim was to identify the rate of complications requiring a secondary procedure within a 12-month period after each index procedure.

Methods

We performed a retrospective review of the PearlDiver patient record database (www.pearldiverinc.com; PearlDiver Inc., Fort Wayne, IN, USA) for the years 2007 through 2010. This is a commercially available, insurance company database of >12 million orthopedic patients that is searchable by Current Procedural Terminology (CPT) codes from the United Healthcare insurance provider (United Healthcare, Minnetonka, MN, USA).

To track major procedural trends in open stabilization procedures, we conducted a search using the CPT codes associated with the following 4 procedures: open Bankart repair [23455], coracoid transfer [23462], anterior glenoid bone grafting [23460], and posterior glenoid bone grafting [23465]. We were able to report the frequency of procedures performed but were unable to report the incidence of each index procedure as the PearlDiver database does not release the aggregate patient population size.

Next, to evaluate for postoperative complications after open shoulder stabilization, we tracked 5 categorized complication groups for a 12-month postoperative period for each of the 4 index procedures. The CPT codes for the 5 complication groups—dislocation with closed treatment, manipulation under anesthesia, reoperation

with arthroscopy, reoperation with open surgery, and others (infection or arthroplasty)—are listed in Table I. A case of complication was identified when 1 of the 4 index procedure codes was followed by a specific complication-related CPT code within the 12-month period after the index procedure for each unique patient identifier. We calculated the incidence of each complication group and compared it by index procedure type as well as by age group (10–24, 25–54, and >55 years).

χ^2 analysis was used to determine the statistical significance among complication groups with regard to index procedure and age. Linear regression was used to assess the significance of trends over time. A *P* value of < .05 was considered to be significant.

Results

A total of 2678 open shoulder stabilization procedures were performed during the 4-year period 2007–2010, with 2101 open Bankart repairs, 302 coracoid transfers, and 79 anterior and 196 posterior glenoid bone grafting procedures identified. Within the 12-month postoperative period, the average total number of patients who required an additional procedure was 12.3%. Table II shows the annual number of procedures performed and rate of complication.

During the 4-year study period, there was a significant decrease in open Bankart repair from 82.5% (672) to 69.8% (388) relative

Table II
Summary of number of index procedures performed and associated complication rate by year

Year	Open stabilization procedures	No. of complications	Complication rate (%)
2007	815	79	9.7
2008	671	95	14.2
2009	636	83	13
2010	556	69	12.4
Total	2656	326	12.3

Trends in Open Shoulder Stabilization

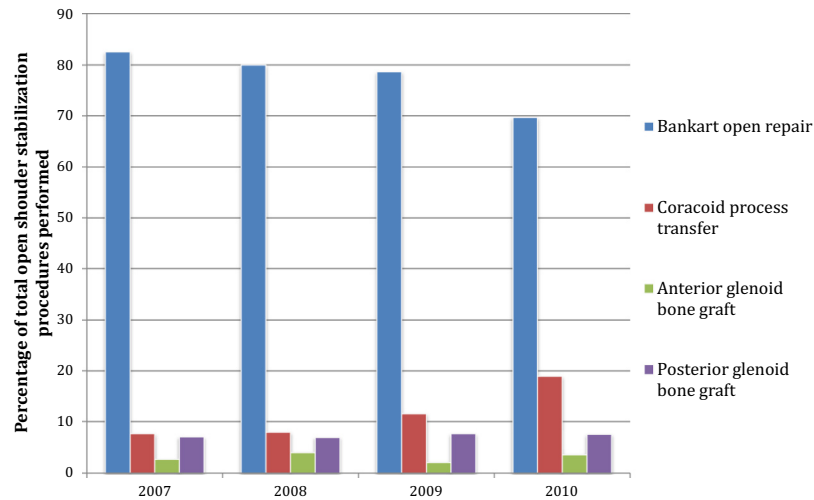


Figure 1 Relative percentage of open procedures performed. The number of Bankart procedures significantly decreased by year, whereas the use of coracoid transfers increased yearly. There was no significant change in the use of glenoid bone grafting procedures.

to all open procedures ($P < .01$) (Fig. 1). The number of coracoid process transfers increased from 63 to 106 ($P = .204$). There was no significant yearly change in the number of anterior glenoid bone graft ($P = .833$) or posterior glenoid bone graft ($P = .757$) procedures performed.

Of the 4 index procedures, posterior glenoid bone grafting was associated with the highest number of patients who required an additional procedure (20.7%), whereas open Bankart stabilization demonstrated the lowest number of patients who required an additional procedure (10.8%). This difference was statistically significant ($P < .01$) (Fig. 2). The average number of patients who required a secondary procedure after a bone transfer (coracoid, anterior glenoid bone grafting, and posterior glenoid bone grafting) was 19.3%. The type of complication by procedure is represented in Table III.

The age group >55 years had the highest additional procedure rate at 25.9%, followed by the age group 25–54 years at 13.6% and

then the age group 10–24 years at 9.8% ($P < .01$) (Fig. 3). The most common additional procedure varied by age group (Fig. 4). Open reoperation was the most common additional procedure in the age group 10–24 years at 3.4%; arthroscopic reoperation in the age group 25–54 years at 4.3%; other (incision and drainage or arthroplasty) in the age group >55 years at 12.4%.

Discussion

Given the continued evolution of arthroscopic shoulder surgery and its popularization during the last 20 years,¹ there has been a significant increase in the number of arthroscopic stabilization procedures performed.^{29,49} This has corresponded with a decline in open surgical management of shoulder instability, which now consists of only approximately 10% of all shoulder stabilization procedures.⁴⁹ However, open stabilization is still indicated in many specific

Complication Rate by Index Procedure Type

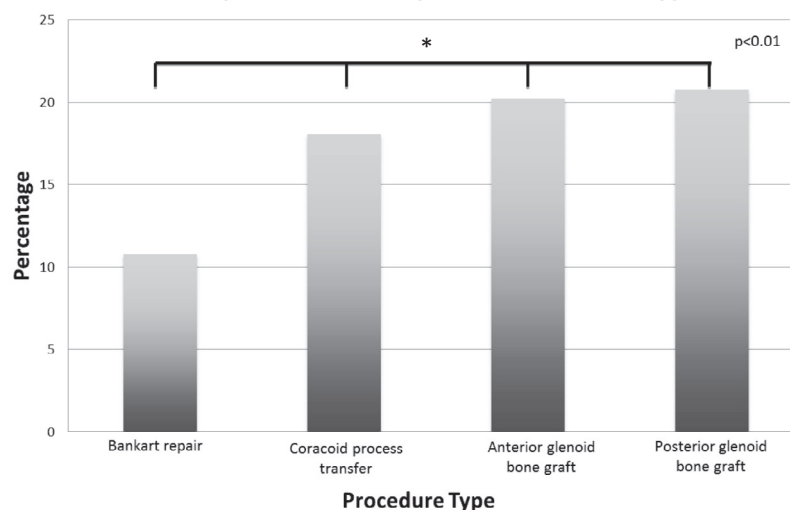


Figure 2 Complication rate for each initial operation performed. For bone transfer procedures (coracoid, anterior glenoid bone grafting, and posterior glenoid bone grafting), average rate was 19.2% compared with 10.8% for open Bankart repair. There was a significant difference observed among groups ($P < .01$).

Table III
Breakdown of additional procedures performed per index operation type

	Open Bankart		Coracoid process transfer		Anterior glenoid bone graft		Posterior glenoid bone graft	
	No.	%	No.	%	No.	%	No.	%
Dislocation—closed treatment	34	1.6	12	2.3	3	3.8	3	1.5
Closed adhesion release	53	2.5	2	0.7	4	5	3	1.5
Reoperation—arthroscopy	70	3.3	11	3.6	3	3.8	11	5.6
Reoperation—open surgery	50	2.4	23	7.6	2	2.5	4	2.0
Other (incision and drainage or arthroplasty)	22	1.0	8	2.6	4	5	19	9.7

instances.^{6,30,32} Open stabilization procedures are still regarded as equal or superior to arthroscopic approaches, demonstrating a lower rate of symptomatic instability.^{4,25} Yet, there are few large-scale studies that investigate common postoperative complications requiring reoperation after open shoulder stabilization procedures.

This study demonstrated a decline in total number of open procedures performed by 31.7% (from 815 to 556) from 2007 to 2010. Interestingly, this decline was largely the result of a decline in the number of open Bankart procedures performed. This finding is consistent with prior work by Owens et al,²⁹ which showed a significant

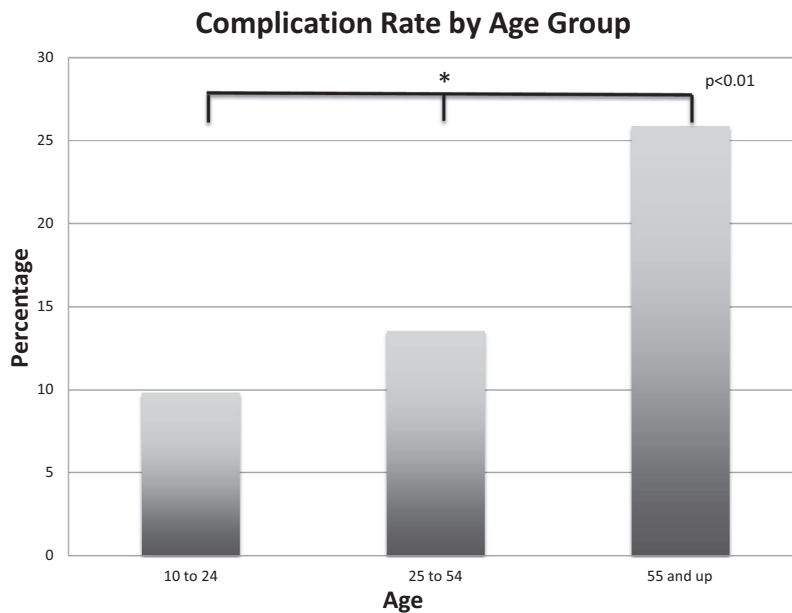


Figure 3 Additional procedures required delineated by age group. The overall rate of complication was the highest in the age category 55+ years and the lowest in the age category 10–24 years.

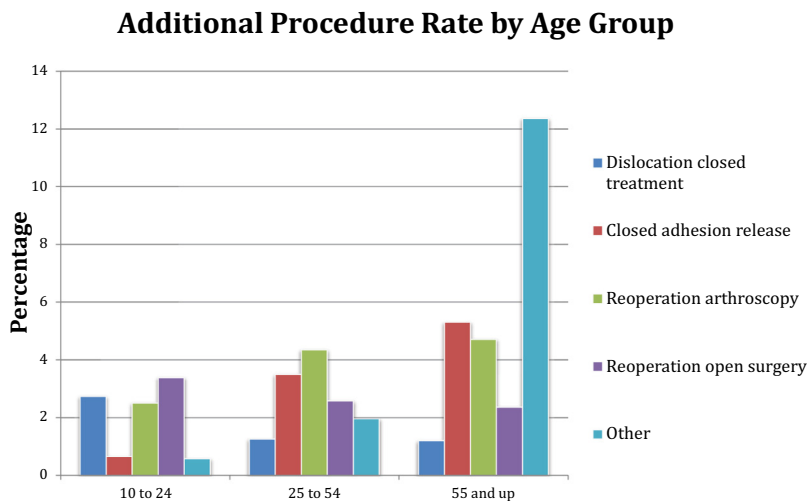


Figure 4 Secondary procedure rate categorized by age group.

decline in open Bankart procedures and corresponding increase in arthroscopic Bankart procedures from 2003 to 2008.

Despite the significant reduction in number of open Bankart procedures observed during the study period, this operation is still the most commonly performed open stabilization procedure. To date, there have been multiple studies showing results to be comparable or even superior to arthroscopic repair,^{15,25,33} with the most common complications being recurrent instability, ranging from 6.7% to 10.3% in long-term follow-up. However, recent studies^{4,27} have presented some contrary data indicating advantages of bone transfer procedures compared with the Bankart repair. A quantitative synthesis by Longo et al²⁷ showed a significantly lower recurrence rate after glenoid bone grafting stabilization compared with Bankart repair. Of note, the study compiled both open and arthroscopic data for comparison. The current study, which solely analyzed open procedures, found a significantly lower rate of additional procedures at the 1-year postoperative time point after open Bankart repair (10.8%) compared with all 3 bone transfer procedures (19.2%). Furthermore, the open Bankart had a lower complication rate in each subcategory compared with each of the bone transfer procedures, except with regard to postoperative stiffness requiring manipulation under anesthesia (open Bankart at 2.5% vs. coracoid transfer at 0.7% and posterior glenoid bone grafting at 1.5%) (Table III).

Whereas the open and arthroscopic Bankart procedure predominates as the most commonly used and preferred surgical intervention for shoulder instability, there are clinical scenarios in which using open bone transfer procedures may be advantageous, including significant glenoid bone loss and revision stabilization. Yet, despite the perceived efficacy of these procedures, there are limited data on their use. A study by Bessi re et al⁴ identified the open Latarjet as having lower recurrence rate and better Rowe scores at a 6-year follow-up compared with arthroscopic Bankart repairs. A systematic review by Longo et al²⁷ demonstrated lower recurrence rates associated with glenoid bone grafting procedures compared with the Bankart repair. Furthermore, for contact athletes, the use of the coracoid transfer to augment Bankart repair has recently been advocated.^{20,47} Despite good clinical outcomes, overall adaptation of these techniques has been slow because of the technical demand of these procedures, the risk of promoting premature arthritis, the potential loss of range of motion, and the potential for neurologic injury. Additional postoperative procedures as well as the variance in the rate of additional procedures after open shoulder stabilization vary significantly, depending on the procedure performed and the time of follow-up. There are few studies that report short-term complications after coracoid transfers, the majority of which suffer from a small patient sample population.

Shah et al⁴² presented results of 47 Latarjet operations, demonstrating an overall complication rate of 25% (6% infection, 10% neurologic injury, and 8% recurrence) within the first 6 months postoperatively. In a long-term meta-analysis by Griesser et al,¹⁷ a total complication rate of 30% was observed with a mean clinical follow-up of 6.8 years. Recurrent anterior dislocation and subluxation rates were 2.9% and 5.8%, respectively; of note, the majority of dislocations (73%) occurred within the first year preoperatively, and nearly 7% of patients required a reoperation. In a systematic literature review by Longo et al,²⁷ the mean dislocation-subluxation rate was 7.5%, with a range of 0%–19%. In the current study, the 1-year postoperative average rate of additional procedures after coracoid transfer was 18.1%, based on 302 procedures performed during the 4-year study period. Of this cohort, 10.9% of patients required either arthroscopic or open reoperation, 3.9% presented with dislocation requiring closed reduction, 2.6% required either incision and drainage or arthroplasty, and 0.65% had postoperative stiffness requiring manipulation under anesthesia.

There is controversy about the superiority of coracoid transfer to anterior glenoid bone graft procedures. A systematic review of literature by Beran et al³ indicated a lack of strong evidence to

support coracoid transfer as a more efficacious technique compared with free autograft or allograft. Currently, as demonstrated in this study, anterior bone grafts are less commonly used by orthopedic surgeons than coracoid transfers. According to a review by Longo et al,²⁷ the Eden-Hybinette operation was associated with a higher average recurrence rate (9.8%) compared with coracoid transfer (7.5%) as well as with a higher risk for development of postoperative osteoarthritis. Overall, our study found an additional procedure rate of 20.3% for anterior bone grafting at 1 year postoperatively to be significantly higher compared with the rate of 18.1% for the coracoid transfer procedure.

Glenoid bone grafting transfer for posterior shoulder instability remains an uncommon and often salvage surgical procedure. Because of low prevalence of this condition, the data about complications after posterior open glenoid bone grafting stabilization are based on a few case series studies, and thus there are limited data about procedure incidence. Sirveaux et al⁴⁴ reported excellent results of glenoid bone grafting surgery in 18 patients (9 treated with a glenoid bone graft from posterior acromion, 9 from iliac crest). After a mean 13-year follow-up, they did not report any recurrence of instability; however, 30% of patients experienced apprehension. In another study, Barbier et al² performed the operation in 8 patients, and after 3-year follow-up, there was 80% satisfaction with the outcome; however, 3 of 8 patients required reoperation. Our database analysis showed an additional procedure after posterior glenoid bone grafting to have the highest incidence, with a mean of 20.8%. This study was unique in that it was able to analyze a large sample of procedures (196 operations between 2007 and 2010).

We report a significantly higher overall complication rate in the oldest population (age group >55 years) compared with the age groups 10–24 years and 25–54 years. Furthermore, our study found dislocation requiring closed reduction at 2.7% as well as open reoperation at 3.4% to be the highest in the younger age group (10–24 years) compared with the other age groups, indicating a higher rate of dislocation in the younger population. These findings are consistent with multiple studies demonstrating a higher dislocation rate in young patients.^{16,34,46} Conversely, the older age group was at significantly higher risk for secondary procedures, including incision and drainage or arthroplasty (12.4%). Other studies have demonstrated that older patients are at an elevated risk of infection after both orthopedic and nonorthopedic procedures.^{12,37,41} This finding is likely secondary to the increased rate of comorbidities in the older age group that may be associated with diminished immune function. Finally, arthroplasty for failed instability surgery is considered a salvage procedure. However, this may be the only option for an older patient with failed instability surgery and an unstable and in some cases arthritic shoulder.

There were many limitations to this study. Given that this is a database study in which we are solely able to use CPT codes to identify additional procedures, we were unable to analyze functional outcomes or quality of life information after each procedure. Furthermore, this study was not able to delve deeper into the clinical intricacies of surgical decision-making, given limited access to preoperative information and individual risk factors, such as a patient's level of physical activity, participation in competitive athletics, mechanism of dislocation (traumatic vs. nontraumatic), or presence and degree of preoperative osseous defect. Furthermore, we were not able to definitively determine whether the reoperation was on the same side as the index operation; however, given the short time between operations, this was the clinical presumption.

Conclusion

Based on a sample of the PearlDiver database from 2007 to 2010 of 2678 open stabilization procedures, a significant decline in the

relative use of open Bankart repairs was observed during the study period with a concomitant increase in use of the coracoid transfer. In contrast, the relative use of glenoid bone grafting procedures did not change significantly during the study period. Our analysis estimates a rate of additional procedures of 10.8% for open Bankart repairs and 19.2% for bone transfer procedures within a 1-year post-operative period. Therefore, the use of a bone transfer procedure was correlated with a significantly higher reoperation rate than open Bankart repair, particularly in the older patient cohort. Further studies comparing reoperation rates of open procedures with contemporary arthroscopic techniques are required.

Disclaimer

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