Systematic Review

Long-Term Outcomes After Bankart Shoulder Stabilization

Joshua D. Harris, M.D., Anil K. Gupta, M.D., M.B.A., Nathan A. Mall, M.D., Geoffrey D. Abrams, M.D., Frank M. McCormick, M.D., Brian J. Cole, M.D., M.B.A., Bernard R. Bach Jr., M.D., Anthony A. Romeo, M.D., and Nikhil N. Verma, M.D.

Purpose: The purposes of this study were (1) to analyze long-term outcomes in patients who have undergone open or arthroscopic Bankart repair and (2) to evaluate study methodologic quality through validated tools. **Methods:** We performed a systematic review of Level I to IV Evidence using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Clinical outcome studies after open or arthroscopic Bankart repair with a minimum of 5 years' follow-up were analyzed. Clinical and radiographic outcomes were extracted and reported. Study methodologic quality was evaluated with Modified Coleman Methodology Scores and Quality Appraisal Tool scores. **Results:** We analyzed 26 studies (1,781 patients). All but 2 studies were Level III or IV Evidence with low Modified Coleman Methodology Scores and Quality Appraisal Tool scores. Patients analyzed were young (mean age, 28 years) male patients (81%) with unilateral dominant shoulder (61%), post-traumatic recurrent (mean of 11 dislocations before surgery) anterior shoulder instability without significant glenoid bone loss. The mean length of clinical follow-up was 11 years. There was no significant difference in recurrence of instability with arthroscopic (11%) versus open (8%) techniques ($P = .06$). There was no significant difference in instability recurrence with arthroscopic suture anchor versus open Bankart repair (8.5% *v* 8%, $P = .82$). There was a significant difference in rate of return to sport between open (89%) and arthroscopic (74%) techniques ($P < .01$), whereas no significant difference was observed between arthroscopic suture anchor (87%) and open repair (89%) ($P = .43$). There was no significant difference in the rate of postoperative osteoarthritis between arthroscopic suture anchor and open Bankart repair (26% and 33%, respectively; $P = .059$). There was no significant difference in Rowe or Constant scores between groups ($P > .05$). **Conclusions:** Surgical treatment of anterior shoulder instability using arthroscopic suture anchor and open Bankart techniques yields similar long-term clinical outcomes, with no significant difference in the rate of recurrent instability, clinical outcome scores, or rate of return to sport. No significant difference was shown in the incidence of postoperative osteoarthritis with open versus arthroscopic suture anchor repair. Study methodologic quality was poor, with most studies having Level III or IV Evidence. **Level of Evidence:** Level IV, systematic review of studies with Level I through IV Evidence.

Traumatic anterior glenohumeral instability is common, with an estimated incidence of 11.2 cases per 100,000 persons per year.[1] Bankart[2] was the first author to recognize the pathognomonic lesion of anterior-inferior capsulolabral disruption associated with anterior shoulder dislocations. Controversy exists with regard to treatment of patients with an initial dislocation, but it is generally accepted that patients with recurrent instability warrant consideration for surgical stabilization.[3] Repair of this capsulolabral disruption has become the standard treatment for this pathology.[4,5] Initially, surgical treatment was performed with open procedures to repair the lesion with or without a capsular shift.[6] More recently, however, arthroscopic techniques for repair of the Bankart lesion have predominated.[7]

Even with the high frequency of anterior shoulder dislocations and the large number of stabilizations performed, studies with a large number of patients and long-term follow-up are sparse. There are a number of studies reporting long-term follow-up after both open and arthroscopic Bankart procedures, but the number of patients in most of these investigations is small. The findings of these investigations may not be adequately powered to detect the true incidence of

From the Division of Sports Medicine, Department of Orthopedic Surgery, Rush Medical College of Rush University, Rush University Medical Center, Chicago, Illinois, U.S.A.

Winner of the 2013 AANA J. Whit Ewing Resident/Fellow Essay Award—Clinical.

The authors report that they have no conflicts of interest in the authorship and publication of this article.

Received October 4, 2012; accepted November 6, 2012.

Address correspondence to Joshua D. Harris, M.D., Midwest Orthopaedics at Rush, Rush University Medical Center, 1611 W Harrison St, Chicago, IL 60612, U.S.A. E-mail: joshuaharrismd@gmail.com

0749-8063/12651/$36.00

http://dx.doi.org/10.1016/j.arthro.2012.11.010

complications after surgical repair. Furthermore, postoperative recurrent instability has been poorly reported, with mixed definitions of instability, dislocation, and subluxation. A systematic review, therefore, would be useful to more closely evaluate these measures, as well as pool clinical data for a more thorough evaluation. Furthermore, a methodologic assessment of these long-term outcome studies has not been performed to determine study quality.

The purpose of this systematic review is to analyze and compare the long-term (minimum of 5 years) clinical and radiographic outcomes in patients who have undergone open or arthroscopic Bankart shoulder stabilization. A secondary purpose of this investigation is to evaluate study methodologic quality and bias through validated assessment tools. We hypothesized that patients included in this investigation would have low redislocation rates, improved clinical outcomes compared with their preoperative state, and mild/minor radiographic signs of glenohumeral arthritis. Furthermore, we hypothesized that there would be no significant difference in recurrence of instability or radiographic arthritis between arthroscopic and open Bankart shoulder stabilization.

Methods

We performed a systematic review of publicly available evidence using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines with a PRISMA checklist.[8] Three independent reviewers (board-eligible orthopaedic surgeons) completed the search. The search was performed on July 31, 2012. The following databases were used: Medline, SportDiscus, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and Cochrane Central Register of Controlled Trials. The following terms were searched: Bankart, shoulder, instability, dislocation, and subluxation. Inclusion criteria were English-language studies reporting clinical outcomes after open or arthroscopic Bankart shoulder stabilization surgery with a minimum of 5 years' follow-up. Exclusion criteria included studies with less than 5 years' clinical follow-up, non–English-language studies, basic science studies, surgical technique studies, letters to the editor, biomechanical studies, systematic reviews/meta-analyses, and studies of duplicate patient populations, as well as studies of revisions, posterior instability, SLAP tears, rotator cuff tears, acute fracture, malunion, and nonunion. Levels of Evidence I, II, III, and IV were deemed inclusive (per the Oxford Centre for Evidence-Based Medicine used by the American version of the *Journal of Bone and Joint Surgery*[9] and *Arthroscopy*) if published in the English language and with a mean clinical follow-up of a minimum 5 years. Both E-published and print journal articles were acceptable. However, meeting abstracts and proceedings were disallowed. In the event of disagreement on final study inclusion for analysis, the senior author made the final decision. All references within included studies were cross-referenced for potential inclusion if omitted from the initial search. If 2 or more separate studies reported on a duplicate population of patients (e.g., different lengths of follow-up), only the more/most recent study was retained for final analysis. Figure 1 shows our search algorithm to generate the final studies for inclusion and analysis.

Study methodologic quality and bias were evaluated with the Modified Coleman Methodology Score (MCMS) and Quality Appraisal Tool (QAT) score. Both of these study quality checklists have been used in prior orthopaedic and sports medicine research, applicable to both randomized and nonrandomized controlled trials.[10-12] The MCMS is a 15-item instrument with a scaled potential score ranging from 0 to 100, with scores of 85 to 100 deemed excellent; 70 to 84, good; 55 to 69, fair; and less than 55, poor.[13] MCMSs were compared by publication year, level of evidence, and surgical technique (open *v* arthroscopic). QAT scores are calculated with a 12-item instrument, with scoring for each item at 0, 1, or 2.[14] Thus scores may range from 0 to 24, with the percentage of total equaling the study's quality rating.

Descriptive statistics were calculated for each study and parameter analyzed/variable. Continuous variable data were reported as mean ± standard deviation (weighted means where applicable). Categorical data were reported as frequencies with percentages. For all statistical analyses, $P < .05$ was deemed statistically significant. Patient, surgical, and study data were compared by use of 2-sample and 2-proportion z test calculators with α of .05 because of the difference in sample sizes between compared groups. Linear regression analysis was used to determine relations between level of evidence and publication date versus study methodologic quality measures (MCMS and QAT). SPSS software (version 18.0; IBM, Armonk, NY) was used for statistical analysis.

Results

Twenty-six studies were identified for inclusion.[15-40] There were 17 studies with Level IV Evidence and only 1 with Level I Evidence (randomized controlled trial).[26] In 4 studies (15%) patients from multiple centers were enrolled and operated on. Of the studies, 3 (12%) reported the presence of a financial conflict of interest, whereas 17 denied conflicts (65%) and 6 (23%) failed to report the presence or absence of conflicts. Overall, the majority of patients were young (mean age, 28 years) male patients (81%) with unilateral dominant shoulder (61%), post-traumatic recurrent (mean of 11 dislocations before surgery over a mean of 3.5 years) anterior shoulder instability without significant glenoid bone loss

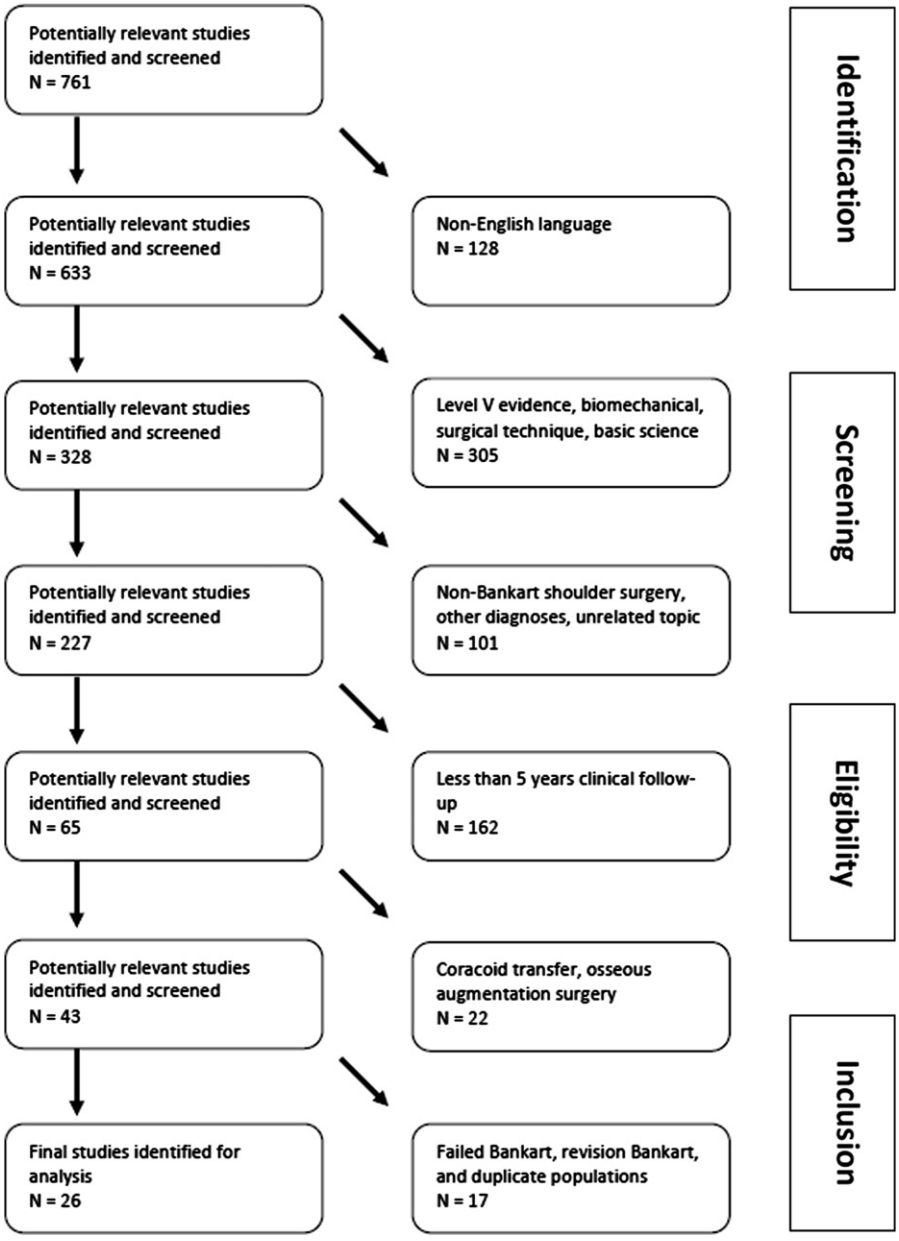

Fig 1. Systematic review search algorithm using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines within Medline database. After application of all exclusion criteria, 26 studies were identified for final analysis.

(Tables 1 and 2). Of the analyzed shoulders at follow-up, 51% and 41% percent underwent open and arthroscopic Bankart repair, respectively (Table 1). Suture anchors, tacks, and the Caspari technique were used in 34%, 34%, and 32%, respectively, of those undergoing arthroscopic Bankart repair (Table 1). The mean length of clinical follow-up was 11 years, with 52% of patients also having radiographic follow-up.

Study Methodologic Quality

Several patterns were shown across all studies based on study methodologic quality. Study level of evidence was significantly associated with the MCMS ($P = .042$) and QAT score ($P = .003$) (Fig 2). Later publication dates were also significantly associated with higher methodologic quality by the MCMS ($P = .017$) and QAT score ($P = .025$) (Fig 3). The mean MCMS overall was 40.1 (poor rating), and the mean QAT score was 17.3 (72% quality rating). The only Level I Evidence study analyzed had an MCMS and QAT score of 62 (fair) and 24 (100% quality rating), respectively. A comparison of arthroscopic studies (n = 12), open studies (n = 12), and comparative studies of the 2 techniques (n = 2) showed higher MCMSs and QAT scores for comparative studies (50 ± 17 and 21 ± 4.2, respectively) versus both isolated arthroscopic (38.3 ± 7.3 and 17 ± 2.7, respectively) and open (40.3 ± 7.9 and 17.1 ± 2.4, respectively) Bankart studies (z value, 0.96 [$P = .338$]

Table 1. Patient, Shoulder, and Surgical Demographic Data From Analyzed Studies

	n (%)
No. of studies	26
No. of patients	1,781*
Male patients	1,097 (81%)
Female patients	264 (19%)
No. of shoulders	1,813†
No. of patients available at follow-up	1,427 (80.1%)
Mean patient age (yr)	27.9 ± 7.3
Age range (yr)	14-65
No. of shoulders available at follow-up	1,434 (79.1%)
Right	136 (53%)
Left	121 (47%)
Dominant	540 (61%)
Nondominant	351 (39%)
Length of follow-up (yr)	11.3 ± 6.5
No. of patients with radiographic follow-up	735 (52%)
No. of patients with independent observer assessing outcome	816 (57%)
Mean No. of prior dislocations	11.0
Mean age at time of first dislocation (yr)	20.0
Duration of symptoms/instability (yr)	3.5
Mean No. of prior surgeries	0.013 (24 total cases of revision instability in all analyzed studies)
No. of open Bankart repairs	731
No. of arthroscopic Bankart repairs	584
Suture anchors	200
Tacks	199
Caspari technique	185
No. of other non-analyzed techniques	
Bristow-Latarjet and Putti-Platt	119
Concomitant surgical procedures	
SLAP repair	27
Rotator cuff repair	14
SLAP debridement	8
Rotator cuff debridement	3
No. of outcome measures used	
Clinical	13
General health	1
Limb specific	1
Shoulder specific	8
Disease specific	3
Validated in instability	2
Radiographic	3

*Patient gender was reported for 1,361 patients.
†Thirty-two bilateral.

Table 2. Selected Indications and Inclusion and Exclusion Criteria From Analyzed Studies

	Description
Indications for surgery	Recurrent post-traumatic unilateral anterior shoulder instability (25 studies)
	First-time traumatic unilateral anterior shoulder dislocation (1 study)
Study inclusion criteria	Post-traumatic anterior instability on history and physical examination, failure of nonoperative management
	Age >30 yr
	Age <40 yr
	Age >50 yr
	Collision athletes
Study exclusion criteria	Posterior or multidirectional instability
	Bony glenoid deficiency >20%-25%, inverted-pear shape
	No significant Hill-Sachs defect
	Rotator cuff tear
	Long head of biceps tendon pathology
	Acromioclavicular joint pathology
	No differentiation and/or definition of what recurrent instability entailed (dislocation, subluxation, or instability)

and 0.79 [$P = .428$], respectively) (Fig 4). The overall mean MCMS and QAT score were 40.1 (poor rating) and 17.3 (72% quality rating), respectively.

Clinical Outcomes

Arthroscopic Bankart With Anchors. In 5 studies (200 patients) outcomes were reported after arthroscopic Bankart repair using suture anchors with a mean follow-up of 7.3 years (Table 3).[20,23,24,29,33] There were 17 recurrent dislocations (8.5%) and 8 subluxations (4%) at a mean of 2.2 years postoperatively. Sixty percent of recurrent instability was due to new trauma. The necessity for revision stabilization surgery was only reported in 2 studies (8 of 14 patients with recurrence of instability, 57%). In 2 studies (91 patients) radiographic outcomes were reported at a mean of 9.0 years' follow-up using the Samilson and Buscayret classification systems: 11 mild degenerative changes (12%), 11 moderate (12%), and 2 severe (2%). There was an 83% rate of return to sport at preinjury levels in analyzed studies. One study compared outcomes of open and arthroscopic Bankart using suture anchors, showing no significant difference in clinical outcomes (Rowe, Constant, visual analog scale) or rate of return to sport.[33] There was, however, a significantly greater rate of recurrent instability (25% *v* 12.5%, $P < .05$) after arthroscopic Bankart. The Rowe score was used and significantly improved in all 5 studies (mean, 84.6) at a mean follow-up of 7.3 years. The Constant score

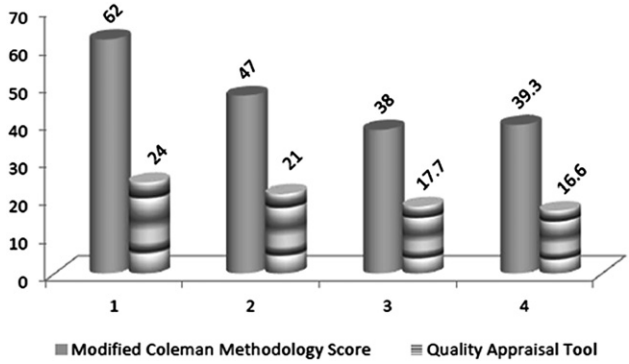

Fig 2. Mean study methodologic quality per level of evidence based on MCMS and QAT score. As study level of evidence increased, MCMS and QAT significantly increased ($P < .05$).

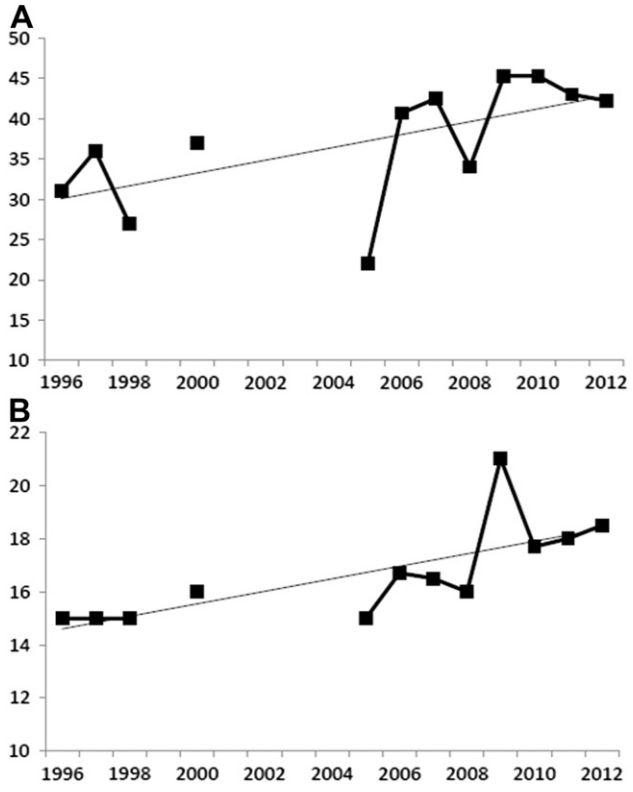

Fig 3. (A) MCMS per year. The mean MCMS overall was 40.1. The possible scaled score ranged from 0 to 100: excellent, 85 to 100; good, 70 to 84; fair, 55 to 69; and poor, less than 55. Later publication date was significantly associated with higher MCMS ($P < .05$). (B) QAT score per year. The mean QAT score overall was 17.3 (72% quality rating). The possible score ranged from 0 to 24. Later publication date was significantly associated with higher QAT score ($P < .05$).

was used and significantly improved in 3 studies (104 patients) (mean, 90.6) at a mean follow-up of 7.3 years.

Arthroscopic Bankart With Tack. In 5 studies (199 patients) outcomes were reported after arthroscopic Bankart repair using tacks with a mean follow-up of 11.5 years (Table 4).[16-18,25,34] The Western Ontario Shoulder Instability Index (WOSI) score (mean, 419) was used in 3 studies (143 patients) at a mean follow-up of 12.7 years. The Rowe score (mean, 92.0) was used in 2 studies (52 patients) with a mean follow-up of 8.2 years. The Constant score (mean, 82.3) was used in 3 studies (135 patients) with a mean follow-up of 11.1 years. There were 34 recurrent dislocations (17%) and 14 subluxations (7%) at a mean of 3.1 years postoperatively. Forty-eight percent of reported recurrent instability was due to new trauma (although the cause of instability was not reported in all cases). The necessity for revision stabilization surgery was reported in 4 studies (14 of 47 patients with recurrence of instability, 30%). Radiographic outcomes were reported by 3 studies (137 patients) at a mean of 11.8 years' follow-up using the Samilson and Rosenberg classification systems: 52 mild (38%), 20 moderate (15%), and 4 severe (3%). When reported (2 studies), there was a 53% rate of return to sport at preinjury levels.

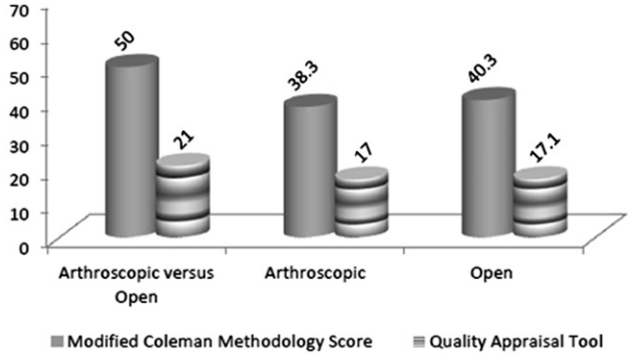

Fig 4. Comparative studies of open and arthroscopic Bankart repair showed higher MCMSs and QAT scores than isolated arthroscopic or open Bankart repair studies (z value, 0.96 [$P = .338$] and 0.79 [$P = .428$], respectively).

Arthroscopic Bankart With Caspari Transglenoid Technique. In 5 studies (185 patients) outcomes were reported after arthroscopic Bankart repair using a transglenoid Caspari technique with a mean follow-up of 8.4 years (Table 5).[15,24,36,37,40] The Rowe score (mean, 88.8) was used in 4 studies (180 patients) with a mean of 8.8 years' follow-up. The Constant score (mean, 88.1) was used in 2 studies (76 patients) with a mean of 11.8 years' follow-up. There were 14 recurrent dislocations (8%) and 6 subluxations (3%) at a mean of 1.2 years postoperatively. Thirty-five percent of reported recurrent instability was due to new trauma (although the cause of instability was not reported in all cases). The necessity for revision stabilization surgery was reported in 3 studies (8 of 12 patients with recurrence of instability, 67%). In 2 studies (116 patients) radiographic outcomes were reported at a mean of 9.4 years' follow-up using the Samilson classification system: 22 mild (12%), 11 moderate (6%), and 2 severe (1%). When reported (2 studies), there was a 79% rate of return to sport at preinjury levels. Two studies compared outcomes of open and arthroscopic Bankart repair using the Caspari transglenoid technique, showing no significant difference in recurrence of instability, radiographic evidence of osteoarthritis, or the following scores: Rowe; University of California, Los Angeles; Constant; Simple Shoulder Test; or American Shoulder and Elbow Surgeons (ASES).[15,36]

Open Bankart. In 15 studies (731 patients) outcomes were reported after open Bankart repair with a mean follow-up of 13.1 years (Table 6).[15,19,21,22,26-28,30-33,35,36,38,39] The Rowe score (mean, 85.6) was used in 11 studies (543 patients) with a mean of 13.1 years' follow-up. The Constant score (mean, 82.2) was used in 5 studies

Table 3. Arthroscopic Bankart Repair With Suture Anchors

Study	Year Published	Years of Patient Enrollment	Mean Patient Age (yr)	No. of Arthroscopic Bankart Repairs (Suture Anchor)	Mean Follow-Up (yr)	Clinical and Radiographic Outcomes
Rhee et al.[33]	2006	1994-2000	20	12	6	Open versus arthroscopic Bankart repair in collision athletes VAS, Rowe (89 *v* 87), and Constant (87 *v* 87) scores improved in both groups ($P > .05$) Recurrent instability in 25% (4) after arthroscopic repair (significantly greater [$P < .05$]) versus 12.5% in open repair (4); 3 in arthroscopic group and 2 in open group required revision surgery 83% return to near preinjury level of sport
Kim et al.[24]	2009	1992-2002	37.5	32	6.4	Arthroscopic Bankart with suture anchor versus Caspari technique in non-athletes No significant difference in Rowe (90 *v* 90) or Constant (95 *v* 92) scores between groups No significant difference in recurrence rates (6% *v* 7%) 1 dislocation and 1 subluxation at mean of 3.5 yr postoperatively (suture anchor) (2 traumatic) 1 dislocation and 1 subluxation at mean of 4.6 yr postoperatively (Caspari) (1 traumatic)
Porcellini et al.[29]	2007	1996-2001	28	65	5.6	Arthroscopic Bankart repair with suture anchor for acute and chronic bony Bankart repair Rowe score significantly improved in acute (59 to 92) and chronic (44 to 61) groups 3% redislocation rate (1 acute and 1 chronic) at mean of 1.5 yr postoperatively
Castagna et al.[23]	2010	1995-1997	26.3	31	10.9	84% patient satisfaction Significant improvement in SST (11.2), UCLA (32), and Rowe (80) scores 16% and 7% atraumatic and traumatic recurrent instability, respectively, at 3.7 yr 3 of 7 recurrences (43%) occurred >6 yr after surgery; 6 of 7 (86%) were in contact athletes 71% rate of return to sport at preinjury level; 97% rate of return to work Radiographs at follow-up: 61% none and 29% with mild and 10% with moderate degenerative changes (Samilson) No correlation between radiographs and clinical outcome
Franceschi et al.[20]	2011	1996-2005	27.6	60	8	Significant improvement in Rowe score (88) and Constant score (89) Higher No. of preoperative dislocations, greater duration follow-up, and reduced external rotation in abduction influenced Constant and Rowe scores Radiographs at follow-up: 22% rate of degenerative changes (Buscayret)—4% mild, 14% moderate, and 4% severe Recurrence of instability in 10 of 60 (17%) (within first 2 yr postoperatively); 5 required revision surgery 88% rate of return to sport

SST, Simple Shoulder Test; UCLA, University of California, Los Angeles; VAS, visual analog scale.

(195 patients) with a mean of 13.2 years' follow-up. There were 55 recurrent dislocations (8%) and 40 subluxations (5%) at a mean of 3.7 years postoperatively. Twenty-four percent of reported recurrent instability was due to trauma (although the cause of instability was not reported in all cases). The necessity for revision stabilization surgery was reported in 13 studies (18 of 95 patients with recurrence of instability, 19%). In 6 studies (329 patients) radiographic outcomes were reported at a mean of 14 years' follow-up using the Samilson classification system: 75 mild (23%), 17 moderate (5%), and 16 severe (5%). When reported (6 studies), there was an 89% rate of return to sport at preinjury levels.

Table 4. Arthroscopic Bankart Repair With Tacks

Study	Year Published	Years of Patient Enrollment	Mean Patient Age (yr)	No. of Arthroscopic Bankart Repairs (Tacks)	Mean Follow-Up (yr)	Clinical and Radiographic Outcomes
Kavaja et al.[17]	2012	1994-1998	29	83	13	75% extremely satisfied/satisfied GH arthrosis (Samilson) in 68% of shoulders at follow-up (80% of these were mild) Mean WOOS score, 280 (85% of maximum); WOSI score, 457 (78% of maximum) Mean Constant score at follow-up, 78 23% rate of recurrent dislocation (19); 4 required revision surgery
Elmlund et al.[16]	2012	NR	31	34	7.9	Final follow-up Rowe and Constant scores were 93 and 88, respectively Radiographs at follow-up: 24% minor and 18% moderate degenerative changes (Rosenberg) No correlation between radiographs and Rowe or Constant scores Recurrent dislocation in 3 (9%) and recurrent subluxation in 3 (9%)
Privitera et al.[18]	2012	1992-1999	25	20	13.5	Mean WOSI and DASH scores were 357 (83%) and 7.3, respectively. WOSI significantly lower in surgical versus contralateral shoulder (83% *v* 97%) Main DASH significantly lower in surgical versus contralateral shoulder (0.39 *v* 6.79) Recurrent dislocation in 5 (25%) (mean, 4.2 yr postoperatively); 3 required revision surgery 40% rate of return to sport at preinjury level Radiographic follow-up: 20% mild, 25% moderate, and 15% severe degenerative changes (Rosenberg)
Owens et al.[25]	2009	1992-1998	20.3	40	11.7	Mean SANE score, 92; WOSI, 372 (82% of maximum); SST score, 11; ASES score, 91; SF-36 PCS score, 94; and Tegner score, 6.5 Shoulder 93.3% of preinjury function 91% of patients would have same surgery again Recurrent dislocation in 6 (14%) and subluxation in 9 (21%) at mean of 3.1 yr postoperatively; 6 required revision surgery (4 for dislocation and 2 for subluxation)
Marquardt et al.[34]	2006	1995-1996	26.8	18	8.7	Significant increase in Rowe score (33 to 90), Constant score (91), and ASES score (92) 64% rate of return to sport at preinjury level 1 recurrent dislocation (5.6%) and 1 subluxation (5.6%) at mean of 10 mo postoperatively; 1 required revision surgery

DASH, Disabilities of the Arm, Shoulder and Hand; GH, glenohumeral; NR, not reported; SANE, Single Assessment Numeric Evaluation; SF-36 PCS, Short Form 36 Physical Component Score; SST, Simple Shoulder Test; WOOS, Western Ontario Osteoarthritis of the Shoulder.

Comparison of Open and Arthroscopic Bankart Repairs

Clinical follow-up after open Bankart repair was significantly longer than that after arthroscopic repair (13.1 years *v* 9.1 years, $P < .001$) (Table 7). The rate of recurrent dislocation was not significantly different between the open and arthroscopic repairs ($P = .063$), arthroscopic suture anchor and open repairs ($P = .82$), arthroscopic Caspari and open repairs ($P = .99$), and arthroscopic suture anchor and arthroscopic Caspari repairs ($P = .86$). The rate of recurrent dislocation was significantly greater for arthroscopic tacks versus suture anchors ($P = .01$), arthroscopic tacks versus arthroscopic Caspari repairs ($P = .008$), and arthroscopic tacks versus open repairs ($P < .001$). The timing of recurrent instability, however, was significantly earlier after arthroscopic versus open repair (2.5 years *v* 3.7 years, $P < .01$). The difference in postoperative rate of development of osteoarthritis was significantly higher after arthroscopic versus open repair (39% *v* 33%, $P = .024$), although this rate was inclusive of mild, moderate, and severe disease. In the comparison of arthroscopic suture anchor (26%) and open (33%) Bankart repair, no significant difference was found ($P = .059$). The difference in rate of return to sport at preinjury levels was significant (74% for arthroscopic repair *v* 89% for open repair,

Table 5. Arthroscopic Bankart With Transglenoid Caspari Technique

Study	Year Published	Years of Patient Enrollment	Mean Patient Age (yr)	No. of Arthroscopic Bankart Repairs (Transglenoid Caspari)	Mean Follow-Up (yr)	Clinical and Radiographic Outcomes
Zaffagnini et al.[15]	2012	1990-1999	36.5	49	14.7	Arthroscopic transglenoid Caspari technique versus open Bankart repair No significant difference in Rowe, UCLA, and Constant scores at follow-up Arthroscopic versus open: Rowe score, 85 versus 83; UCLA score, 26 versus 27; and Constant score, 86 versus 87 No difference in recurrent dislocation: 6 (12.5%) in arthroscopic group and 3 (9%) in open group No difference in radiographic degenerative changes between groups (Samilson) Arthroscopic: 12 mild (25%), 4 moderate (8%), and 2 severe (4%) Open: 9 mild (27%), 4 moderate (12%), and 2 severe (6%)
Sperling et al.[36]	2005	1992-1999	57	5	6.5	Arthroscopic transglenoid Caspari technique versus open Bankart repair in older patients No recurrent instability in any patient No difference in follow-up SST or ASES score
Boszotta and Helperstorfer[37]	2000	1988-1995	27.2	67	5.5	Mean Rowe score at follow-up, 91 Recurrent dislocation in 5 (7%) at mean of 6 mo postoperatively (2 traumatic); 3 required revision surgery (1 patient twice) 85% rate of return to sport Radiographs at follow-up: 10 mild (15%) and 7 moderate (10%) (Samilson)
Pagnani et al.[40]	1996	1983-1989	24.6	37	5.6	22 (59%) excellent, 5 (14%) good, 3 (8%) fair, and 7 (19%) failed per Rowe score at follow-up Recurrent instability in 7 (19%) (2 dislocation and 5 subluxation) (mean, 15 mo postoperatively); 5 required revision surgery 67% rate of return to sport at preinjury level

SST, Simple Shoulder Test; UCLA, University of California at Los Angeles.

$P < .01$). However, a comparison of arthroscopic suture anchor repair versus open Bankart repair showed no significant difference (87% *v* 89%, $P = .43$); in contrast, a significant difference was observed between both arthroscopic tack and Caspari techniques versus open repair ($P < .001$ for both). There was no significant difference in Rowe or Constant scores between groups ($P > .05$).

Discussion

The purpose of this systematic review was to analyze and compare the long-term clinical and radiographic outcomes in patients who have undergone open and arthroscopic Bankart shoulder stabilization. A secondary purpose of this investigation was to evaluate study methodologic quality and bias through validated assessment tools. We hypothesized that patients would have low redislocation rates, improved clinical outcomes compared with their preoperative state, and mild/minor radiographic signs of glenohumeral arthritis. Furthermore, we hypothesized that there would be no significant difference in recurrence of instability or radiographic arthritis between arthroscopic and open Bankart shoulder stabilization. Our hypotheses were partially confirmed. There was no significant difference in recurrence of instability with arthroscopic (11%) versus open (8%) techniques. However, suture anchor, tack, and Caspari techniques were analyzed together in this arthroscopic group. Comparison of instability recurrence with arthroscopic suture anchor versus open Bankart repair showed no significant difference (8.5% *v* 8%). Furthermore, although there was a significant difference in rate of return to sport between open (89%) and all-arthroscopic (74%) techniques, no significant difference was observed between arthroscopic suture anchor repair (87%) and open repair (89%). There was no significant difference in the rate of postoperative osteoarthritis between arthroscopic suture anchor and open Bankart repair (26% and 33%, respectively). There was no significant difference in Rowe or Constant scores between groups. Study methodologic quality was poor, with all but 2 studies having either Level III or IV evidence.

Table 6. Open Bankart Repair

Study	Year Published	Years of Patient Enrollment	Mean Patient Age (yr)	No. of Open Bankart Repairs	Mean Follow-Up (yr)	Clinical and Radiographic Outcomes
Hovelius et al.[19]	2011	1988-1995	27.6	88	17	Open Bankart versus Bristow-Latarjet repair No description of preoperative glenoid or humeral bone loss 89% very satisfied/satisfied; mean WOSI score at final follow-up, 79 Recurrent instability in 25 shoulders (28%); surgery was required in 5 shoulders
Salomonsson et al.[26]	2009	1991-1995	27.5	33	10	Randomized controlled trial of open Bankart versus Putti-Platt repair with 10-yr follow-up No difference in Rowe score at follow-up (90 *v* 90); WOSI was 357 (83% of maximum) Recurrent dislocation/subluxation in 19 of 33 (58%): 8 at <2 yr postoperatively, 8 at 2-5 yr postoperatively, and 3 at 5-10 yr postoperatively; 4 required revision surgery
Cheung et al.[27]	2008	1979-1983	26	34	21.9	Comparative study of primary versus revision open Bankart repair with 22-yr follow-up Mean ASES score, 84; Rowe score, excellent in 16, good in 10, fair in 2, and poor in 4 No significant difference in SST score ($P = .17$) or ASES score (90 *v* 72, $P = .12$) Significant difference ($P = .05$) in Rowe score favoring primary over revision Bankart repair No recurrent dislocations and 4 recurrent subluxations No revision surgery and 2 total shoulder arthroplasties (at 12 and 25 yr postoperatively)
Fabre et al.[21]	2010	1975-1982	25	50	28	Open Bankart repair in contact athletes (73% of cohort) at 28-yr follow-up Mean Rowe score, 82; Walch-Duplay score, 82; and 96% patient satisfaction Recurrent dislocation in 8 (16%) (all traumatic) at mean of 3 yr postoperatively 2 required revision surgery (at mean of 2.5 yr postoperatively) 82% rate of return to sport at preinjury level (100% in 31 rugby players) Radiographs at follow-up: 18 mild (36%), 5 moderate (10%), and 6 severe (12%) (Samilson)
Ogawa et al.[22]	2010	1984-2000	21.9	167	8.7	Mean Rowe score at follow-up, 92 Recurrent instability in 8 (5%) (1 dislocation and 7 subluxations) at mean of 3.7 yr postoperatively No revision surgery 12 (7%) had degenerative changes on preoperative radiographs 30 (18%) had OA on radiographs at final follow-up (Samilson) Postoperative OA correlated with No. of preoperative dislocations, male gender, and glenoid bone loss >20%
Berendes et al.[28]	2007	1989-1993	28	31	11	Mean Rowe score, 90; Constant score at follow-up, 96 Recurrent dislocations in 3 (10%) (2 traumatic) and 4 subluxations (13%) 94% rate of return to sport at preinjury level Radiographs at follow-up: 9 mild (29%) and 1 severe (3%) (Samilson)

Study	Year Published	Years of Patient Enrollment	Mean Patient Age (yr)	No. of Open Bankart Repairs	Mean Follow-Up (yr)	Clinical and Radiographic Outcomes
Strahovnik and Fokter[30]	2006	1987-2000	30	83	9	Mean Rowe score, 63; Constant score at follow-up, 77 62 patients (75%) were satisfied and would have same surgery again Recurrent dislocations in 5 (6%) (4 traumatic) at mean of 5.7 yr postoperatively; 1 required revision surgery Recurrent subluxations in 5 (6%) at mean of 2 yr postoperatively; no revision surgery
Langford et al.[31]	2006	1988-2001	29	41	6.5	Mean Rowe score at follow-up, 96 Recurrent dislocations in 2 (5%) and 1 subluxation (2%) (all traumatic) at 6 mo postoperatively; no revision surgery 92% rate of return to sport at preinjury level
Pelet et al.[32]	2006	1962-1980	23.6	30	29	100% patients were satisfied and would have same surgery again Mean Rowe score, 80; ASES score, 12.6; Constant score at follow-up, 73 ($P < .05$ *v* contralateral shoulder) 3 recurrent dislocations (10%) (2 traumatic) at mean of 4 yr postoperatively 1 required revision surgery 100% rate of return to sport at preinjury level Radiographs at follow-up: 5 moderate (17%) and 7 severe (23%) (Samilson) 5 (17%) needed total shoulder arthroplasty at mean of 26.6 yr postoperatively
Magnusson et al.[35]	2006	1994	27	18	7.5	Mean Rowe score, 94; Constant score at follow-up, 89 2 recurrent dislocations (11%) (1 traumatic) and 1 subluxation (6%) at mean of 3.7 yr postoperatively; all 3 required revision surgery 4 of 18 minor (22%) and 1 of 18 moderate preoperative OA (6%) on radiographs (Rosenberg) Final follow-up radiographs: 11 of 18 mild (61%), 1 moderate (6%), and 1 severe (6%)
Takeda et al.[38]	1998	1986-1994	22	25	5.4	Mean Rowe score at follow-up, 96 No recurrence of instability postoperatively 88% rate of return to sport at preinjury level In contact sports, 77% rate of return to sport at preinjury level
Gill et al.[39]	1997	1978-1986	21.4	60	11.9	54 of 60 patients (90%) satisfied and would have same surgery again ASES score: 43 excellent (72%), 9 good (15%), 3 fair (5%), and 1 poor (2%) 3 recurrent dislocations (5%) (all traumatic) at mean of 5.3 yr postoperatively; no revision surgery needed

OA, osteoarthritis.

Table 7. Comparison of All Surgical Techniques Analyzed

	Arthroscopic Bankart Repair With Suture Anchors	Arthroscopic Bankart Repair With Tacks	Arthroscopic Bankart Repair With Transglenoid Caspari Technique	All-Arthroscopic Bankart Techniques (n = 584)	Open Bankart Repair (n = 731)
Length of follow-up (yr)	7.3	11.5	8.4	9.1	13.1
Recurrent dislocation rate (%)	8.5	17	8	11	8
Recurrent subluxation rate (%)	4	7	3	5	5
Timing of recurrent instability (yr)	2.2	3.1	1.2	2.5	3.7
% of recurrently unstable patients who underwent revision surgery	57	30	67	41	19
% of recurrent instability due to new trauma	60	48	35	48	24
% of radiographic OA					
Overall	26	56	19	39	33
Mild	12	38	12	25	23
Moderate	12	15	6	12	5
Severe	2	3	1	2	5
Rate of return to sport at preinjury levels	87	53	79	74	89
Final follow-up Rowe score	84.6	92.0	88.8	87.2	85.6
Final follow-up Constant score	90.6	82.3	88.1	86.4	82.2
Final follow-up WOSI score	NR	419	NR	NR	NR

NR, not reported; OA, osteoarthritis.

Patients with symptomatic recurrent anterior shoulder instability in whom nonoperative management has failed are often offered surgical stabilization. The traditional gold standard for treatment of anterior instability was the open Bankart repair.[41] The anatomic capsulolabral reconstruction afforded by the open technique was, and still is, considered by many investigators as the reference standard by which arthroscopic treatments are compared.[31] Arthroscopic techniques for Bankart repair have evolved from the original transglenoid pull-through Caspari technique to use of arthroscopic tacks to the use of contemporary suture anchors, theoretically improving reliability and predictability of outcome. This study sought to determine whether differences exist in clinical and radiographic outcomes between the traditional gold-standard open Bankart repair and both older and newer arthroscopic techniques. Technologic advances in arthroscopic procedures over time have allowed surgeons to take advantage of lower surgical morbidity, decreased pain, improved cosmesis, and the ability to treat additional intra-articular pathology, without any compromise in surgical outcomes. This systematic review has confirmed the similarity in outcomes with newer arthroscopic techniques (arthroscopic suture anchors, with dates of enrollment of studies analyzing this technique from 1992 to 2005) and open techniques. However, it must be recognized and emphasized that certain patient factors, such as glenoid bone loss (an exclusion criterion of this review), are contraindications to arthroscopic management of anterior shoulder instability.

The subjective and objective measures used in this review to assess surgical outcome and "success" are also heterogeneous. Recurrence of instability falls along a spectrum of apprehension in provocative positions to subluxations to dislocations. Use of this parameter alone as the sole measure of success is unwise. This, in fact, was an exclusion criterion for the study search strategy. On account of this, 1 study was excluded because of mixed reporting of recurrent instability, including dislocations and subluxations, within the article.[42] To appropriately evaluate postoperative instability, a study must report outcomes of true dislocations (humeral head articular surface not articulating with articular face of glenoid, requirement of manual reduction), subluxations (shoulder "popped out and back in"), and apprehension (no episodes of shoulder dislocation or subluxation) where only fear of dislocation/subluxation is felt with provocative physical examination maneuvers. Thus, for purposes of this review, the data were kept clean and reported as recurrent dislocation, because this is an absolute quantifiable variable. The excluded study did report a remarkably high recurrent instability rate.[42] However, it admittedly reported that it defined "strict criteria for recurrent dislocation, including both a full subluxation and dislocation." This is misleading and biases the results. The findings of that study should not be discounted, however, because other early-term and midterm outcome studies have illustrated similar findings. These studies were not analyzed for purposes of this review, though. However, they possibly used the same qualification of recurrent instability, with potential overestimation of recurrent dislocation because of inclusion of apprehension and subluxation. This systematic review also intended to analyze not only recurrence of instability but also clinical outcomes using validated questionnaires, return-to-sport rates, and radiographs, as well as the methodologic quality of studies used as the basis for treatment decisions.

Unfortunately, this review largely failed to use properly developed, validated, reliable, and responsive outcome measures for shoulder instability. Twenty-five different scoring systems have been used to evaluate the treatment outcomes for shoulder instability.[43] In the evaluation of patients with instability, only 3 outcome instruments have been properly developed: WOSI[44]; Melbourne Instability Shoulder Score (MISS)[45]; and Disabilities of the Arm, Shoulder and Hand score.[46] Thus these instruments have been developed with specific measurement goals in mind, with an intent to develop expert- and patient-based items in the instrument, and generation of a questionnaire that is to be administered to the patient. In patients with instability, the following outcome questionnaires have been found to be reliable[47]: Shoulder Rating Questionnaire,[48] MISS,[45] WOSI,[44] Oxford Instability Score,[49] and Simple Shoulder Test.[50] Thus a reliable outcome instrument will consistently produce the same result each time one uses it, provided that no change has occurred. Reliability is a necessary, but not sufficient, characteristic of an outcome measure. In addition, outcome measurement tools must also be responsive and valid. In order for any outcome instrument to be responsive, it must first be reliable. Responsiveness of an outcome measure is defined as the ability to detect and evaluate changes in patients over time if they have occurred. The Shoulder Rating Questionnaire, WOSI, MISS, Oxford Instability Score, and ASES[51,52] self-reported scores have shown responsiveness.[47] Finally, an outcome instrument must show validity, the degree to which the instrument measures what is intended to be measured. Only the WOSI and ASES self-reported scores have been deemed valid for instability.[47] On the basis of these psychometric properties, a score's ability to detect and warrant a clinical decision is predicated on its measurement if it meets a minimum clinically important difference. This is defined as the smallest amount of change in a clinical outcome assessment tool that is perceived, by the patient, as a significant difference. Given the previously mentioned descriptors, an excellent analysis of evidence-based medicine for shoulder instability has recently concluded that the WOSI and MISS (and potentially the ASES self-reported score) should be used to evaluate the clinical outcome of patients with shoulder instability.[47] A recent systematic review of patient-administered shoulder instability functional scores concluded that, though nonetheless based on limited data, the WOSI appears to be the best instrument to evaluate instability given its superior reliability and responsiveness.[43] In addition to the previously mentioned scores, the Walch-Duplay score (largely used in Europe) has been found to correlate with the WOSI.[53] However, the WOSI is more sensitive than the Walch-Duplay score in the evaluation of patient satisfaction.[53]

In addition to clinical scores and recurrence, radiographic outcomes are of significant importance. Anatomic capsulolabral reconstruction should provide stability without overconstraint. Historical instability procedures (e.g., Putti-Platt or Magnusson-Stack) overtightened the glenohumeral articulation, increasing contact pressure, leading to arthritis. The Bankart procedure more closely approximates the normal anatomy of the shoulder. Arthritis that occurs after instability surgery is confounded by many factors, including both preoperative factors (number of instability episodes, direction of instability, patient age, severity of injury, degree of bone loss) and postoperative factors (assessment with radiographs during follow-up, recurrence of instability, amount of constraint, implant placement, implant location). The ability to ascertain the degree of contribution of each of these factors is complicated. This review did not show a significant difference in the development of degenerative change with arthroscopic suture anchors; however, this finding is further confounded by the fact that only 52% of analyzed studies reported long-term radiographic outcomes.

Limitations

The limitations of this systematic review are relegated to the limitations of the studies that it describes. Selection bias was present because of the retrospective nature of the majority of analyzed studies. Furthermore, heterogeneity in patient populations (e.g., age, activity level, occupation, and shoulder dominance) contributed to bias. Performance bias was present because of the heterogeneity in surgical techniques performed and analyzed. Transfer bias was evident because of the different lengths of clinical and radiographic follow-up and patients lost to follow-up. Nevertheless, this study is powerful in that it is the largest review in the literature with the longest duration of follow-up. Detection bias was present because of the heterogeneity in clinical and radiographic outcomes used. The lack of use of validated outcomes further confounds the conclusions drawn. In addition, only 57% of studies used an independent observer for postoperative clinical and/or radiographic assessment. The study designs—largely retrospective case series, case-control studies, and comparative studies—are not optimal for the assessment of whether any true difference exists in an intervention. Only high-quality, well-designed randomized controlled trials comparing techniques are able to provide evidence with the power to alter clinical decision making.

Conclusions

Surgical treatment of anterior shoulder instability using arthroscopic suture anchor and open Bankart techniques yields similar long-term clinical outcomes, with no significant difference in the rate of recurrent instability, clinical outcome scores, or rate of return to sport. No significant difference was shown in the

incidence of postoperative osteoarthritis with open versus arthroscopic suture anchor repair. Study methodologic quality was poor, with most studies having Level III or IV Evidence.

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