Systematic Review

Do Arthroscopic and Open Stabilization Techniques Restore Equivalent Stability to the Shoulder in the Setting of Anterior Glenohumeral Instability? A Systematic Review of Overlapping Meta-analyses

Peter N. Chalmers, M.D., Randy Mascarenhas, M.D., F.R.C.S.C., Timothy Leroux, M.D., Eli T. Sayegh, B.S., Nikhil N. Verma, M.D., Brian J. Cole, M.D., M.B.A., and Anthony A. Romeo, M.D.

Purpose: Shoulder instability frequently recurs in young patients without operative treatment. Both open and arthroscopic approaches to shoulder stabilization with labral repair and capsulorrhaphy have been described and are routinely used. Multiple trials have been conducted to compare these approaches, with multiple meta-analyses performed to synthesize these trials; however, the results remain controversial. The purpose of this study was to critically evaluate the current meta-analyses to identify the current state of the art. **Methods:** In this study we evaluate available scientific support for the ability of both arthroscopic and open soft-tissue stabilization techniques to restore stability of the shoulder by performing a systematic review of the literature for previous meta-analyses. Data were extracted for rates of recurrence and patient outcomes. Study quality was measured with the Oxman-Guyatt and QUOROM (Quality of Reporting of Meta-analyses) systems. The Jadad algorithm was applied independently by 4 authors to determine which meta-analysis provided the highest level of available evidence. **Results:** After application of the inclusion and exclusion criteria, 8 meta-analyses were included. Both studies published prior 2007 concluded that open stabilization provided lower recurrence rates than arthroscopic stabilization, the 3 studies published in 2007 are discordant, and all 3 studies published after 2008 concluded that open and arthroscopic stabilization provided equivalent results. Two meta-analyses had low Oxman-Guyatt scores (<3) signifying major flaws. Four authors independently selected the same meta-analysis as providing the highest quality of evidence using the Jadad algorithm, and this meta-analysis found no difference in recurrence rates between open and arthroscopic stabilization. **Conclusions:** This systematic review of overlapping meta-analyses comparing arthroscopic and open shoulder stabilization suggests that according to current best available evidence, there are no significant differences in failure rates. **Level of Evidence:** Level IV, systematic review of Level I through IV studies.

The glenohumeral joint is the most unstable joint in the human body,[1] with traumatic instability occurring in up to 5% of men aged between 20 and 30 years and at a rate of 11.2 per 100,000 person-years for all ages.[2,3] The primary pathology that occurs with dislocation involves disruption of the anteroinferior capsule and labrum and is seen in 86% to 97% of shoulders after an anterior instability event.[4,5] This lesion is frequently called the "Bankart lesion" and was originally described in 1923.[6] Recurrent shoulder instability occurs in 25% to 100% of cases treated nonoperatively,[5,7-11] whereas operative treatment reduces

From the Department of Orthopaedic Surgery, Rush University Medical Center (P.N.C., R.M., N.N.V., B.J.C., A.A.R.), Chicago, Illinois, U.S.A.; Department of Orthopaedic Surgery, University of Toronto (T.L.), Toronto, Ontario, Canada; and College of Physicians and Surgeons, Columbia University (E.T.S.), New York, New York, U.S.A.

The authors report the following potential conflict of interest or source of funding: N.N.V. receives support from Minivasive, Smith & Nephew, Arthrex, Athletico, ConMed Linvatec, Miomed, Mitek, Arthrosurface, DJ Orthopaedics, Vindico Medical-Orthopedics Hyperguide, Cymedica, Omeros. B.J.C. receives support from Arthrex, Carticept, Regentis, Zimmer, Medipost, National Institutes of Health, DJ Orthopaedics, Athletico, Ossur, Smith & Nephew, Tornier. A.A.R. receives support from Arthrex, DJO Surgical, Smith & Nephew, Ossur.

Received June 21, 2014; accepted July 9, 2014.

Address correspondence to Peter N. Chalmers, M.D., Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W Harrison St, Ste 300, Chicago, IL 60612, U.S.A. E-mail: p.n.chalmers@gmail.com

0749-8063/14518/$36.00

http://dx.doi.org/10.1016/j.arthro.2014.07.008

the risk of recurrence to 6% to 22% of cases.[7,8,11-13] Although the goals of operative treatment are to repair the capsulolabral-ligamentous envelope to restore physiological glenohumeral stability, debate continues as to the optimal method of repair.

In particular, a significant body of literature has been devoted to the comparison of arthroscopic and open Bankart repairs.[14-20] Proponents of the open technique have argued that it provides the surgeon the ability to provide a more anatomic and secure repair with improved anchor orientation, whereas proponents of the arthroscopic technique have contended that it avoids the complications associated with open approaches (infection, violation of the subscapularis, and arthrofibrosis) while providing an equivalent repair with a faster recovery.[15,17-19] Retrospective comparative trials,[20] case-control studies,[21] and randomized clinical trials[14,22] have been performed in attempts to compare the 2 techniques. In addition, several meta-analyses have been performed, with conflicting results and conclusions.[15,17-19] Debate continues in the literature as to the optimal surgical approach to address recurrent shoulder instability, and both approaches continue to be used frequently in practice.

The purposes of this study were (1) to conduct a systematic review of overlapping meta-analyses comparing open and arthroscopic shoulder stabilization, (2) to provide treatment recommendations based on the best currently available evidence, and (3) to highlight gaps in the literature that require future research. The hypothesis of this study was that methodologic differences within the meta-analyses would more frequently determine conclusions than the available evidence. Of note, although traditionally meta-analysis has been used to describe studies that combine data from randomized clinical trials, for the purposes of this review, all systematic reviews that performed their own statistical analyses are considered meta-analyses, even if Level III evidence and Level IV evidence were included.

Methods

A systematic review of the literature was performed using the PubMed database, Cochrane Database of Systematic Reviews, and Embase database on May 1, 2014. The following search terms were used: open AND arthroscopic AND {shoulder stabilization OR Bankart}. The search was limited to articles written in English. Broad search query terms were used to include all possibly applicable studies. All reviewed articles were then manually cross-referenced to ensure that all potential studies were included.

The abstracts that resulted from these searches were then reviewed by 2 of the study authors. The inclusion criteria were meta-analyses that directly compared open and arthroscopic shoulder stabilization techniques. Cadaveric studies were excluded. The exclusion criteria included studies without clinical outcomes data and those that examined osseous augmentation techniques such as the Latarjet, distal tibial allograft, and iliac crest bone block procedures. Full manuscripts were obtained for those studies that met both the inclusion and exclusion criteria. The references for each of these citations were then manually screened to ensure that no studies were missed. The tables of contents of the *Journal of Bone and Joint Surgery*, *American Journal of Sports Medicine*, *Clinical Orthopaedics and Related Research*, *Arthroscopy*, and *Journal of Shoulder and Elbow Surgery* for the past 2 years were manually searched as well for any additional studies. A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram shows our study selection algorithm (Fig 1). From those studies that met the inclusion criteria, publication data and rationale for repeating meta-analysis (Table 1), clinical endpoints and outcomes (Table 2), search details (Table 3), analysis methodology (Table 4), and details regarding heterogeneity and subgroup analyses (Table 5) were extracted.

Meta-analysis quality was ranked using the QUOROM (Quality of Reporting of Meta-analyses) system.[23] This system provides a method for evaluating meta-analyses based on the quality of their reporting and methodology in 18 categories. Each meta-analysis was awarded a point in each category if it met over half of the criteria given in that category, for a total of 18 points possible. Quality assessment data extracted from individual studies included the modified Coleman score,[24] the Quality Appraisal Tool,[25] and the Cochrane methodologic quality assessment score.[26] In addition, studies that reported bias were recorded.

To determine which of the discordant reviews provided the optimal evidence, the Jadad decision algorithm was used.[27] This methodology determines the source of discordance between systematic reviews, including differences in inclusion/exclusion criteria, quality assessment, statistical analyses, clinical questions, data extraction, and data pooling. Four authors independently applied the algorithm and arrived at a consensus as to which of the systematic reviews provided the best currently available evidence. All statistical analyses were performed in Excel X (Microsoft, Redmond, WA).

Results

Whereas our initial search returned 25 articles, application of the inclusion and exclusion criteria led to inclusion of 8 studies (Fig 1).[12,15,17-19,26,28,29] These studies were published between 2004 and 2013, and all 8 performed a meta-analysis.[12,15,17-19,26,28,29] Six studies reported no conflict of interest,[12,15,19,26,28,29] and 2 studies did not report on the presence or absence of a conflict of interest.[17,18] One study reported only on Level I evidence,[26] 6 reported on Level I to Level III evidence,[12,17-19,28,29] and 1 reported on Level I to Level IV evidence.[15] The studies reported on 184

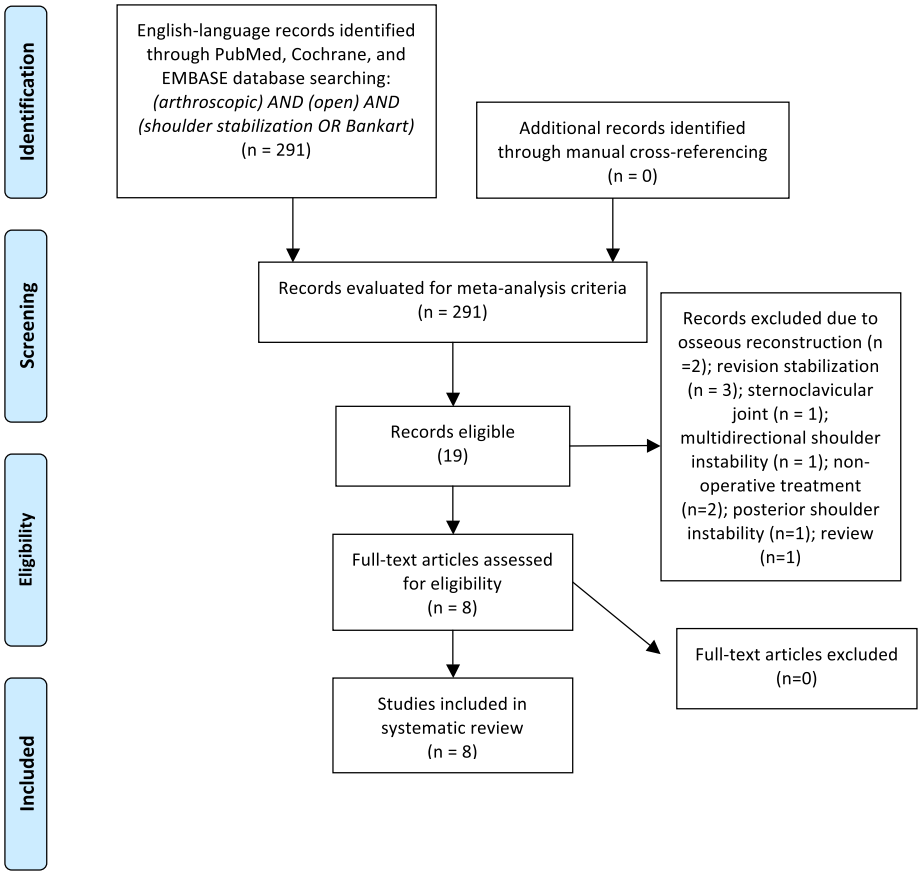

Fig 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram showing application of inclusion and exclusion criteria, as well as number of studies included.

patients[26] to 1,781 patients,[15] with a mean follow-up period of 24 months[12,18] to 136 months.[15]

Authors' Assessment of Prior Systematic Review Literature

In general, authors did not cite the majority of the previously published reviews (Table 1), and many authors did not cite any antecedent reviews.[15,17] No study cited all of the available reviews. Three studies provided no rationale for repeating the systematic review process.[15,17] Of the 5 studies that provided a rationale for repeating the systematic review process, the most frequently cited reasons were inclusion of heterogeneous and/or outdated labral fixation methodologies used before the introduction of suture anchors,[19,26] a failure to assess methodologic quality and interpret findings in the light of methodologic quality,[18,26] an inadequate search,[18] and newly available evidence.[18,19]

Outcome Measures

There was heterogeneity in which aspects of the patients' outcomes were reported by the involved studies (Table 2). Some of this variation stems from variations in the inclusion of apprehension and subluxation in the definition of instability recurrence, including recurrent dislocation, subluxation, and/or apprehension. Specifically, whereas Freedman et al.[28] reported on dislocation recurrence, Harris et al.[15] reported on recurrent subluxation and Ng et al.[18] compared recurrent apprehension. In addition, Freedman et al., Pulavarti et al.,[26] and Hobby et al.[12] all reported on combined subluxation and dislocation with varying findings, whereas Ng et al., Mohtadi et al.,[17] and Lenters et al.[29] all reported on combined dislocation, subluxation, and apprehension with differing results. A further definition of instability recurrence was the need for reoperation, again with varying conclusions reached by the included reviews.[15,17,26,29] Although, in theory, each meta-analysis reported on a similar patient population, there was substantial variance in standard mean differences between the open and arthroscopic cohorts in Rowe scores from 0.4[29] to 5.[26] Objective measures such as strength,[18,26] range of motion,[15,26] and radiographic appearance[15] were infrequently reported, whereas subjective measures such as return to activity were frequently reported.[15,17,18,26,28,29]

Search Methodology

Although all reviews searched PubMed or Medline, they varied as to whether the Excerpta Medica Database

Table 1. Meta-Analyses Citing Previously Published Systematic Reviews or Meta-Analyses and Rationale for Repeating Meta-Analysis

Authors	Date of Publication	Date of Last Literature Search	No. of Systematic Reviews or Meta-Analyses Possible to Cite	No. of Systematic Reviews or Meta-Analyses Cited	Cited Systematic Reviews or Meta-Analyses	Rationale for Repeating Meta-Analysis as Abstracted From Manuscript
Freedman et al.[28]	July 2004	May 2002	0	0	NA	NA
Mohtadi et al.[17]	June 2005	October 2003	0	0	NA	NA
Hobby et al.[12]	September 2007	February 2006	3	2	Freedman et al., Mohtadi et al.	"These included only studies which directly compared techniques and thus claimed to avoid the bias inherent in non-comparative studies. This limited the number of studies available to 11 and six, compared with our 62." "Both previous reviews pooled the results of all arthroscopic techniques in their analyses."
Lenters et al.[29]	February 2007	November 2004	2	2	Freedman et al., Mohtadi et al.	"Several high-quality studies, some of which have included an arthroscopic suture anchor technique, have become available since these prior meta-analyses were performed … This allowed us to examine the influence of both study design and arthroscopic technique."
Ng et al.[18]	June 2007	December 2004	2	2	Robinson et al.,[11] Freedman et al.	"Freedman et al. only used MEDLINE for their primary literature search, which may have limited their number of included studies … [T]hey also neglected to evaluate the methodological quality of their included studies, thus failing to interpret their findings in light of their studies' quality." "More recent studies that compare arthroscopic GH stabilisation using suture anchors with open surgical repair were included in this review."
Pulavarti et al.[26]	October 2009	March 2008	6	3	Freedman et al., Mohtadi et al., Lenters et al.	"All three reviews combined studies with a wide variety of study designs and outcome measures. Appraisal of methodological quality of the included studies was also unclear or insufficient in the reviews of Freedman 2004 and Lenters 2007." "The vast majority of these studies [in the review of Freedman et al.] used either transglenoid sutures or bioabsorbable tacks while performing arthroscopic repairs." "However, the inclusion of studies with a wide variety of study designs of high risk of bias limits the reliability of the findings of this review [of Mohtadi et al.]."
Petrera et al.[19]	March 2010	NA	7	3	Mohtadi et al., Hobby et al., Lenters et al.	"[T]here have been few rigorous trials and meta-analyses comparing these new arthroscopic methods to traditional open techniques … and none compared the same surgical method of fixation." "The strength of our meta-analysis is in strict criteria that led to the inclusion of studies that directly compare open and arthroscopic Bankart repair using suture anchors …" "[A]rticles published after 2002 report better results using suture anchors than previous studies."
Harris et al.[15]	May 2013	July 2012	11	0	NA	NA

GH, glenohumeral; NA, not applicable.

Table 2. Different Outcomes of Interest of Overlapping Reviews

	Freedman et al.[28]	Mohtadi et al.[17]	Hobby et al.[12]	Lenters et al.[29]	Ng et al.[18]	Pulavarti et al.[26]	Petrera et al.[19]	Harris et al.[15]
Clinical endpoints								
Recurrent dislocation	+	−	−	+	−	−	+	+
Recurrent subluxation	−	−	−	−	−	+	−	+
Recurrent apprehension	−	−	−	−	+	+	−	−
Recurrent instability	+	+	+	+	+	+	−	−
Timing of recurrent instability	−	−	−	−	−	−	−	+
Traumatic recurrence	−	+	−	−	−	−	−	+
Reoperation	−	+	−	+	−	+	−	+
Clinical indices								
Rowe score	+	−	−	+	+	+	+	+
Constant score	−	−	−	−	+	+	+	+
WOSI score	−	−	−	−	+	+	−	+
SANE score	−	−	−	−	−	+	−	+
ASES score	−	−	−	−	+	+	+	+
UCLA score	−	−	−	−	+	+	+	+
SST score	−	−	−	−	−	+	−	+
DASH score	−	−	−	−	−	+	−	+
SF-36 PCS	−	−	−	−	−	+	−	+
VAS score	−	−	−	−	−	−	−	+
WOOS score	−	−	−	−	−	−	−	+
Objective function								
Muscle strength	−	−	−	−	+	+	−	−
Range of external rotation	+	−	−	−	+	+	−	+
Range of internal rotation	−	−	−	−	−	+	−	−
Range of forward flexion	−	−	−	−	−	+	−	−
Subjective measures								
Return to activity	+	+	−	+	+	+	−	+
Persistent pain	−	−	−	+	+	+	−	−
Patient satisfaction	−	−	−	−	−	+	−	+
Radiographic endpoint								
Glenohumeral arthritis	−	−	−	−	−	−	−	+
Operative factors and complications								
Operative time	−	−	−	−	−	+	−	−
Overall complication rate	−	−	−	−	+	−	−	−
Infection	+	−	−	−	+	+	−	−
Hardware failure	+	−	−	+	−	+	−	−
Stiffness or motion loss requiring surgery	+	−	−	+	−	+	−	−
Nerve injury	+	−	−	+	+	+	−	−

ASES, American Shoulder and Elbow Surgeons; DASH, Disabilities of the Arm, Shoulder and Hand; SANE, Single Assessment Numeric Evaluation; SF-36 PCS, Short Form 36 Physical Component Score; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles; VAS, visual analog scale; WOOS, Western Ontario Osteoarthritis of the Shoulder; WOSI, Western Ontario Shoulder Instability.

(Embase), Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature, or other databases were included (Table 3). The total number of unique primary studies cited was 62, and the number varied widely from 3 studies[26] to 62 studies,[12] with a median of 11 studies cited.[17,18]

Table 3. Meta-Analyses and Databases Used in Their Literature Searches

		Database						No. of Primary	Primary Studies
Authors	Date of Publication	PubMed	Medline	Embase	CDSR	CINAHL	Other	Studies	Included Only RCTs
Freedman et al.[28]	July 2004	+	−	−	−	−	−	6	−
Mohtadi et al.[17]	June 2005	+	+	−	−	−	−	11	−
Hobby et al.[12]	September 2007	−	+	+	−	+	−	62	−
Lenters et al.[29]	February 2007	+	+	−	+	−	+	18	−
Ng et al.[18]	June 2007	+	+	−	+	+	+	11	−
Pulavarti et al.[26]	October 2009	−	+	+	+	+	+	3	+
Petrera et al.[19]	March 2010	+	+	+	+	−	−	6	−
Harris et al.[15]	May 2013	−	+	−	+	+	+	26	−

CDSR, Cochrane Database of Systematic Reviews; CINAHL, Cumulative Index to Nursing and Allied Health Literature; Embase, Excerpta Medica Database; Medline, Medical Literature Analysis and Retrieval System Online; RCT, randomized controlled trial.

Table 4. Pooling of Data From Primary Studies, QUOROM, and Oxman-Guyatt Scores

Authors	Date of Publication	Heterogeneity Analysis	Recurrent Dislocation		Recurrent Instability		Reoperation (RR)	Rowe Score (SMD)	Return to Activity		Postoperative Complications (OR)	No. of Primary Studies	Primary Studies Included Only RCTs	QUOROM Score	Oxman-Guyatt Score
			RR	OR	RR	OR			RR	OR					
Freedman et al.[28]	July 2004	+	−	+	−	+	−	−*	−	−	+†	6	−	15	2
Mohtadi et al.[17]	June 2005	−	−	−	−	+	−*	−	−	+	−	11	−	13	3
Hobby et al.[12]	September 2007	+	−	−	+	−	−	−	−	−	−	62	−	14	7
Lenters et al.[29]	February 2007	+	+	−	+	−	+	+	+	−	−	18	−	16	7
Ng et al.[18]	June 2007	+	−	−	−	+	−	−*	−	−	−*	11	−	16	6
Pulavarti et al.[26]	October 2009	+	−	−	+	−	−*	+	+	−	−	3	+	17	6
Petrera et al.[19]	March 2010	−	−*	−	−	−	−*	−*	−	−	−	6	−	12	2
Harris et al.[15]	May 2013	−	−*	−	−	−	−*	−*	−*	−	−	26	−	16	5

NOTE. The arthroscopic group in the meta-analysis of Petrera et al. was exclusively composed of suture anchor repairs. Moreover, additional analyses of pooled data, using only Level I and Level II evidence, were performed by Lenters et al. (for recurrent dislocation and reoperation) and Mohtadi et al. (for recurrent dislocation). Similarly, Petrera et al. performed a second meta-analysis of recurrent dislocation and reoperation using only studies published after 2002. All studies performed data pooling.

OR, odds ratio; QUOROM, Quality of Reporting of Meta-analyses; RCT, randomized controlled trial; RR, relative risk; SMD, standardized mean difference.

*Data were pooled for the listed outcome, but no measure of statistical comparison was reported.

†Statistical comparisons were reported for specific complications: hardware failure, nerve injury, infection, and motion loss requiring surgery.

Study Results

Three of the 8 included reviews concluded that open stabilization provides lower recurrence rates than arthroscopic stabilization, all of which were published in 2007 or prior.[17,28,29] A single article published in 2007 found no difference between arthroscopic and open techniques when arthroscopic suture anchor fixation was used but found significantly higher recurrence rates when transglenoid sutures or suture tacks were used.[12] Both studies published prior to 2007 concluded that open stabilization provided lower recurrence rates than arthroscopic stabilization, the 3 studies published in 2007 are discordant, and all 3 studies published after 2008 concluded that open and arthroscopic stabilization provided equivalent results.[15,18,19,26]

Study Quality and Heterogeneity Analyses

QUOROM scores varied from 12 of 18[19] to 17 of 18,[26] with a median of 15.5. Oxman-Guyatt scores ranged from 2 of 7[19,28] to 7 of 7,[12,29] with a median of 5.5 (Table 4). Heterogeneity assessment was statistically measured in only 4 of 8 included reviews.[12,18,26,29] Many other sources of heterogeneity within the underlying patient populations, such as primary study quality (5 studies), gender (3 studies), age (4 studies), follow-up interval (3 studies), and rate of patient follow-up (2 studies), were cited by multiple included reviews (Table 5).

Application of Jadad Decision Algorithm

Four authors independently selected the same path within the Jadad algorithm.[27] Given the included reviews, the decision points within the Jadad algorithm are navigated such that (1) all included reviews address the same study question, (2) the studies vary in the primary source data included, and (3) the selection criteria vary between included reviews. As a result, the highest-quality review is based on (a) the publication characteristics of the source trials, (b) the methodology of the source trials, (c) the language restrictions, and (d) the inclusion of an analysis of individual patient data. Criteria c and d are not applicable. With respect to criterion a, the included studies vary over a wide period and thus more recent reviews are preferred to less recent reviews. With respect to criterion b, reviews that include only Level I evidence have superior methodology. Using these criteria, all 4 authors independently selected the review by Pulavarti et al.[26] as the review offering the current highest-quality evidence. It concluded that open and arthroscopic stabilization do not differ with respect to recurrence of instability.

Discussion

A number of retrospective cohort studies, case-control studies, and randomized clinical trials have attempted

Table 5. Heterogeneity or Subgroup Analysis of Primary Studies

	Freedman et al.[28]	Mohtadi et al.[17]	Hobby et al.[12]	Lenters et al.[29]	Ng et al.[18]	Pulavarti et al.[26]	Petrera et al.[19]	Harris et al.[15]
Statistical heterogeneity analysis	+	−	+	+	+	+	−	−
Subgroup or sensitivity analysis								
Primary study quality	−	−	+	+	+	+	−	+
Gender	+	+	−	−	0	0	−	+
Age	+	+	−	−	0	0	+	+
Dominant arm	−	−	−	−	0	0	0	+
No. of prior dislocations	−	−	−	−	0	0	−	+
No. of prior surgeries	−	−	−	−	−	−	−	+
Age at initial dislocation	−	−	−	−	−	−	−	+
Duration of symptoms before surgery	−	−	−	−	0	0	−	+
Choice of surgical procedure	0	−	−	0	−	0	−	−
Surgical technique	0	0	0	0	0	0	0	0
Concomitant procedures	0	−	−	−	0	−	−	0
Follow-up interval	+	−	0	−	0	0	+	+
Rate of patient follow-up	−	−	−	−	0	+	−	+
Rate of radiographic follow-up	−	−		−	−	−	−	+
Outcome assessed by independent observer	−	−	0	−	−	−	−	+
Cause of recurrence	−	+	−	−	−	−	−	−
Recurrent dislocation: SA *v* open	−	−	−	+	−	−	+	+
Recurrent dislocation: TGS *v* open	+	−	−	+	−	−	−	+
Recurrent dislocation: BT *v* open	+	−	−	+	−	−	−	+
Recurrent dislocation*	−	−	−	−	−	−	−	+
Recurrent subluxation: SA *v* open	−	−	−	−	−	−	−	+†
Recurrent subluxation: TGS *v* open	−	−	−	+	−	−	−	+†
Recurrent subluxation: BT *v* open	−	−	−	+	−	−	−	+†
Recurrent instability: SA *v* open	−	−	+†	+	+	−	−	−
Recurrent instability: TGS *v* open	+	−	+	+	+	−	−	−
Recurrent instability: BT *v* open	+	−	0	+	+	−	−	−
Recurrent instability: AS *v* open	−	−	+	−	−	−	−	−
Recurrent instability*	+	−	+	−	−	−	−	−
Timing of recurrent instability*	−	−	−	−	−	−	−	+†
Trauma-related recurrent instability*	−	−	−	−	−	−	−	+†
Reoperation: SA *v* open	−	−	−	−	−	−	+	−
Reoperation: TGS *v* open	−	−	−	+	−	−	−	−
Reoperation: BT *v* open	−	−	−	+	−	−	−	−
Reoperation*	−	−	−	−	−	−	−	+†
Return to sport: SA *v* open	−	−	−	−	−	−	−	+
Return to sport: TGS *v* open	−	−	−	−	−	−	−	+
Return to sport: BT *v* open	−	−	−	−	−	−	−	+
Rowe score: SA *v* open	−	−	−	+	−	−	−	−
Rowe score: BT *v* open	−	−	−	+	−	−	−	−
Rowe score*	−	−	−	−	−	−	−	+
Constant score*	−	−	−	−	−	−	−	+
Glenohumeral arthritis*	−	−	−	−	−	−	−	+†

NOTE. A plus sign means formal sensitivity or subgroup analysis was performed; a minus sign means formal sensitivity or subgroup analysis was not performed; and zero means descriptive (i.e., non-pooled) data were provided or discussed but no analysis was performed.

AS, arthroscopic staples; BT, arthroscopic bioabsorbable tacks; SA, arthroscopic suture anchors; TGS, arthroscopic transglenoid sutures.

*Arthroscopic techniques were compared with each other.

†Subgroup data were pooled but not statistically compared.

to compare clinical outcomes after arthroscopic and open shoulder stabilization.[14,20-22] Given the vast literature on this topic, numerous systematic reviews and meta-analyses have emerged in an attempt to consolidate the findings of these studies.[12,15,17-19,26,28,29] Though theoretically representing the highest quality of evidence, these meta-analyses are discordant, and our study has thus attempted to determine which of these studies represents the highest level of evidence on this topic to date. Using the Jadad algorithm, 4 authors independently arrived at the conclusion that the review provided by Pulavarti et al.[26] provides the current highest level of evidence and it concludes that there are no differences in recurrence rates between open and arthroscopic shoulder stabilization.

Perhaps the most important consideration when comparing 2 techniques intended to stabilize the glenohumeral joint is the rate of failure, commonly referred to as "recurrent instability." In reviewing the literature over the past 10 years, we found that there is

substantial heterogeneity in the definition of "recurrence," with some authors considering apprehension to constitute recurrence and others defining recurrence only as the need for subsequent stabilization procedures. Such heterogeneity clouds the interpretation of these results and precludes comparison between studies. Reviews reported dislocation recurrence[28]; subluxation recurrence[15]; apprehension recurrence[18]; combined dislocation and subluxation recurrence[12,26,28]; and combined dislocation, subluxation, and apprehension recurrence.[17,18,29] There appears to be a movement among the most recent meta-analyses to define failure using objective measures such as frank dislocation and reoperation.[15] The common argument against this definition is that it may not capture all patients with symptomatic instability (i.e., subluxation or apprehension) if they do not undergo revision stabilization. Given the young age and high activity level within this patient population, patients who fall into this category are likely rare. As such, future studies should focus on objective measures of recurrence such as dislocation events or the need for revision stabilization.

Over the past decade, there has been an exponential increase in the number of systematic reviews and meta-analyses published in the orthopaedic literature. As such, there has been a push to ensure that these studies are performed correctly and to the highest standard. In a recent publication, Wright et al.[30] outlined the requirements for publishing these studies in common orthopaedic journals, including the pooling and statistical comparison of data from only randomized trials. On the basis of their article, only 1 of the 8 articles included in this study fulfilled all criteria.[26] Indeed, in the most recently included review on the subject, Harris et al.[15] stated, "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, and only high-quality, well-designed randomized trials comparing techniques are able to provide evidence with the power to alter clinical decision making."

Within the published reviews, there was a clear pivot point in 2007: both studies published prior to 2007 concluded that open stabilization provided lower recurrence rates than arthroscopic stabilization, the 3 studies published in 2007 are discordant, and all 3 studies published after 2008 concluded that open and arthroscopic stabilization provided equivalent results.[15,17-19,26,28,29] This pattern likely reflects advancement in arthroscopic technique, particularly the use of suture anchors instead of transglenoid sutures or tacks for labral fixation.

Limitations

The included reviews have numerous limitations. Functional outcome scores, subjective outcomes, objective outcomes, and complication rates were incompletely and variably reported within the included reviews. The available studies are likely underpowered and susceptible to type II error. Past reviews included and statistically analyzed lower-quality data, a technique only appropriate when equivalent higher-quality data are not available.[30,31] Indeed, it is striking that there have been twice as many meta-analyses comparing open and arthroscopic Bankart repair as there have been randomized trials.[14,22,32,33] The most recently published randomized clinical trial, which was published after the literature search of the most recently published included review,[15] concluded that recurrence is significantly more likely after arthroscopic stabilization as compared with open stabilization.[22] However, 1 limitation within this study was intergroup heterogeneity in the number of collision athletes (56% *v* 44%)—a known risk factor for failure.[34,35] Given that the 3 prior randomized clinical trials[14,32,36] and the meta-analysis analyzing these trials[26] all concluded that there was no difference between open and arthroscopic stabilization, the best available evidence suggests that open shoulder stabilization and arthroscopic shoulder stabilization provide similar rates of stability.

Conclusions

This systematic review of overlapping meta-analyses comparing arthroscopic and open shoulder stabilization suggests that according to current best available evidence, there are no significant differences in failure rates.

References

1. Kazár B, Relovszky E. Prognosis of primary dislocation of the shoulder. *Acta Orthop Scand* 1969;40:216-224.
2. Goss TP. Anterior glenohumeral instability. *Orthopedics* 1988;11:87-95.
3. Simonet WT, Melton LJ, Cofield RH, Ilstrup DM. Incidence of anterior shoulder dislocation in Olmsted County, Minnesota. *Clin Orthop Relat Res* 1984;(186):186-191.
4. Baker CL, Uribe JW, Whitman C. Arthroscopic evaluation of acute initial anterior shoulder dislocations. *Am J Sports Med* 1990;18:25-28.
5. Taylor DC, Arciero RA. Pathologic changes associated with shoulder dislocations: Arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. *Am J Sports Med* 1997;25:306-311.
6. Bankart AS. Recurrent or habitual dislocation of the shoulder-joint. *BMJ* 1923;2:1132-1133.
7. Arciero RA, Wheeler JH, Ryan JB, McBride JT. Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. *Am J Sports Med* 1994;22:589-594.
8. 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;30:576-580.
9. Hovelius L, Olofsson A, Sandstrom B, et al. Nonoperative treatment of primary anterior shoulder dislocation in patients forty years of age and younger. A prospective twenty-five-year follow-up. *J Bone Joint Surg Am* 2008;90:945-952.
10. Marans HJ, Angel KR, Schemitsch EH, Wedge JH. The fate of traumatic anterior dislocation of the shoulder in children. *J Bone Joint Surg Am* 1992;74:1242-1244.
11. Robinson CM, Howes J, Murdoch H, Will E, Graham C. Functional outcome and risk of recurrent instability after primary traumatic anterior shoulder dislocation in young patients. *J Bone Joint Surg Am* 2006;88:2326-2336.
12. Hobby J, Griffin D, Dunbar M, Boileau P. Is arthroscopic surgery for stabilisation of chronic shoulder instability as effective as open surgery? A systematic review and meta-analysis of 62 studies including 3044 arthroscopic operations. *J Bone Joint Surg Br* 2007;89:1188-1196.
13. Magnusson L, Ejerhed L, Rostgård-Christensen L, et al. A prospective, randomized, clinical and radiographic study after arthroscopic Bankart reconstruction using 2 different types of absorbable tacks. *Arthroscopy* 2006;22:143-151.
14. Bottoni LCR, Smith MEL, Berkowitz MMJ, Towle CRB, Moore CJH. Arthroscopic versus open shoulder stabilization for recurrent anterior instability: A prospective randomized clinical trial. *Am J Sports Med* 2006;34:1730-1737.
15. Harris JD, Gupta AK, Mall NA, et al. Long-term outcomes after Bankart shoulder stabilization. *Arthroscopy* 2013;29:920-933.
16. Kim S-H, Ha K-I, Kim S-H. Bankart repair in traumatic anterior shoulder instability: Open versus arthroscopic technique. *Arthroscopy* 2002;18:755-763.
17. Mohtadi NGH, Bitar IJ, Sasyniuk TM, Hollinshead RM, Harper WP. Arthroscopic versus open repair for traumatic anterior shoulder instability: A meta-analysis. *Arthroscopy* 2005;21:652-658.
18. Ng C, Bialocerkowski A, Hinman R. Effectiveness of arthroscopic versus open surgical stabilisation for the management of traumatic anterior glenohumeral instability. *Int J Evid Based Healthc* 2007;5:182-207.
19. 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;18:1742-1747.
20. Wang C, Ghalambor N, Zarins B, Warner JJP. Arthroscopic versus open Bankart repair: Analysis of patient subjective outcome and cost. *Arthroscopy* 2005;21:1219-1222.
21. Kim HT, Lee JS, Yoo CI. Management of cubitus varus and valgus. *J Bone Joint Surg Am* 2005;87:771-780.
22. Mohtadi NGH, Chan DS, Hollinshead RM, et al. A randomized clinical trial comparing open and arthroscopic stabilization for recurrent traumatic anterior shoulder instability: Two-year follow-up with disease-specific quality-of-life outcomes. *J Bone Joint Surg Am* 2014;96:353-360.
23. Moher D, Cook DJ, Eastwood S, Olkin I, Rennie D, Stroup DF. Improving the quality of reports of meta-analyses of randomised controlled trials: The QUOROM statement. Quality of Reporting of Meta-analyses. *Lancet* 1999;354:1896-1900.
24. Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: Clinical significance of methodological deficiencies and guidelines for future studies. Victorian Institute of Sport Tendon Study Group. *Scand J Med Sci Sports* 2000;10:2-11.
25. Roy J-S, MacDermid JC, Woodhouse LJ. Measuring shoulder function: A systematic review of four questionnaires. *Arthritis Rheum* 2009;61:623-632.
26. Pulavarti RS, Symes TH, Rangan A. Surgical interventions for anterior shoulder instability in adults. *Cochrane Database Syst Rev* 2009:CD005077.
27. Jadad AR, Cook DJ, Browman GP. A guide to interpreting discordant systematic reviews. *CMAJ* 1997;156:1411-1416.
28. Freedman KB, Smith AP, Romeo AA, Cole BJ, Bach BR. Open Bankart repair versus arthroscopic repair with transglenoid sutures or bioabsorbable tacks for recurrent anterior instability of the shoulder: A meta-analysis. *Am J Sports Med* 2004;32:1520-1527.
29. Lenters TR, Wolf FM, Leopold SS, Matsen FA, Franta AK. Arthroscopic compared with open repairs for recurrent anterior shoulder instability. A systematic review and meta-analysis of the literature. *J Bone Joint Surg Am* 2007;89:244-254.
30. Wright JG, Swiontkowski MF, Tolo VT. Meta-analyses and systematic reviews: New guidelines for JBJS. *J Bone Joint Surg Am* 2012;94:1537.
31. Chalmers PN, Mall NA, Moric M, et al. Does ACL reconstruction alter natural history?: A systematic literature review of long-term outcomes. *J Bone Joint Surg Am* 2014;96:292-300.
32. Fabbriciani C, Milano G, Demontis A, Fadda S, Ziranu F, Mulas PD. Arthroscopic versus open treatment of bankart lesion of the shoulder: A prospective randomized study. *Arthroscopy* 2004;20:456-462.
33. Sperber A. Comparison of an arthroscopic and an open procedure for posttraumatic instability of the shoulder: A prospective, randomized multicenter study. *J Shoulder Elbow Surg* 2001;10:105-108.
34. Robinson CM, Dobson RJ. Anterior instability of the shoulder after trauma. *J Bone Joint Surg Br* 2004;86:469-479.
35. Sachs RA, Stone ML, Paxton E, Kuney M, Lin D. Can the need for future surgery for acute traumatic anterior shoulder dislocation be predicted? *J Bone Joint Surg Am* 2007;89:1665-1674.
36. Carreira DS. A prospective outcome evaluation of arthroscopic Bankart repairs: Minimum 2-year follow-up. *Am J Sports Med* 2005;34:771-777.