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RESEARCH

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Knotless versus knotted arthroscopic Bankart repairs for anterior shoulder instability: a systematic review and meta-analysis

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Abstract

Background Arthroscopic Bankart repair can be performed via a more contemporary knotless procedure or a more traditional knotted procedure. Nonetheless, comparisons between these two techniques remain controversial.

Methods Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a comprehensive search of PubMed, EMBASE, Cochrane Library, Scopus, and Web of Science was conducted. Randomized controlled trials (RCTs) and cohort studies directly comparing the knotless and knotted arthroscopic Bankart procedures were included. The primary outcomes were rates of recurrent instability and revision surgeries. Secondary outcomes encompassed number of anchors, operative time, improvements in functional scores including Rowe score and Constant-Murley score (CMS), pain level assessed by the visual analogue scale (VAS) score, range of motion (ROM), adverse events, and radiological results. Quality assessment was performed using RoB2 and MINORS tools. Meta-analysis pooled RCT data using Review Manager 5.4.1, and non-pooled outcomes from cohort studies or limited RCT data were reported separately.

Results This meta-analysis included nine studies with a total of 729 patients. Pooled data from three RCTs demonstrated no significant differences between the two techniques in terms of re-dislocation ($P=0.78$), recurrent anterior subluxation and positive apprehension test ($P=0.78$), revision surgery ($P=0.94$), number of anchors used ($P=0.26$), or improvements in Rowe score ($P=0.15$). For outcomes not suitable for pooling, qualitative analysis of trends indicated comparable outcomes between the groups, except a slightly reduced operative time in the knotless repair group. Adverse events were infrequently reported and occurred at similar rates in both groups. Limited radiological data from one RCT showed no significant differences in MRI parameters at the 24-month follow-up.

Conclusion Both techniques demonstrate comparable clinical outcomes. The only potential advantage of the knotless technique is a possible reduction in operative time, though its clinical significance remains uncertain. Given the limitations of the evidence, these findings should be interpreted cautiously.

Clinical trial number Not applicable.

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Keywords Anterior shoulder instability, Bankart repair, Knotless, Knotted, Meta-analysis

Background

Although debates remain regarding the optimal surgical technique for different patient populations, many surgeons regard Bankart repair as the cornerstone procedure for managing anterior shoulder instability [1, 2]. For patients without significant bone defects, arthroscopic Bankart repair has demonstrated high success rates in restoring stability, improving functional scores, and facilitating return to sports [3–5].

The traditional knotted suture anchor technique provides strong fixation and precise suture tension control, critical for labral reattachment [1, 6–9]. However, it is challenged by the complexity of arthroscopic knot-tying and potential knot-related complications [10–16]. In response, the knotless technique has emerged with promising outcomes [17–28], enhancing efficiency and replicability by avoiding knot-tying [21, 22, 26]. Despite these advantages, the knotless technique is limited by difficulties in achieving optimal suture tension control, uncertainties regarding long-term stability, and higher implant costs [29–33].

Evidence comparing these techniques remains inconclusive. Previous systematic reviews have highlighted their advantages and limitations but were constrained by inconsistent methodologies and limited comparative studies [28–33]. Despite three randomized controlled trials (RCTs) [34–36] suggesting comparable outcomes between knotless and knotted techniques in Bankart repairs, their limited sample sizes and the presence of conflicting cohort studies highlighted the need for a systematic review and meta-analysis to clarify their comparative effectiveness.

This study aims to compare the effectiveness of knotless and knotted arthroscopic Bankart repairs in treating anterior shoulder instability without significant bone defects. We hypothesize that the two techniques yield comparable clinical outcomes.

Methods

Literature search

In rigorous adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [37], this systematic review and meta-analysis was conducted. The study was preregistered in The International Prospective Register of Systematic Reviews (PROSPERO) under the registration ID CRD42024586135. A comprehensive literature search comprising PubMed, EMBASE, Cochrane Library, Scopus, and Web of Science databases was carried out by two independent reviewers (C.W., and M.D.). The library includes all records up to April 1st, 2025. The principal search terms were as follows: ("Knotless" OR "Knot-free") AND ("Knotted" OR "Knot-typing") AND ("anterior shoulder instability" OR "shoulder instability" OR "glenohumeral instability" OR "recurrent shoulder instability") AND ("Bankart" OR "Anteroinferior labral repair"). These terms were adapted as needed to meet the specific requirements of each database (Supplementary Table 1). Any discordance during the search was resolved by engaging a third researcher (L.L.) for consultation.

Inclusion and exclusion criteria

Inclusion criteria: (1) confirmed anterior shoulder instability patients with recurrent dislocations (≥ 2); (2) randomized controlled trials (RCTs) and cohort studies; (3) direct comparison of knotless and knotted arthroscopic Bankart repair.

Exclusion criteria: (1) other shoulder conditions such as rotator cuff tear, infection, tumor, or severe osteoarthritis; (2) prior shoulder surgery; (3) isolated superior labrum anterior to posterior (SLAP) lesions; (4) isolated posterior or multidirectional shoulder instability; (5) surgical technique was not clearly described, or bony reconstructive procedures were used to address significant glenoid defects or Hill-Sachs lesions; (6) neuromuscular diseases, including seizure disorders; (7) non-English documentation.

Data extraction

Two researchers (C.W., and M.D.) independently extracted data from the studies selected, resolving any discrepancies with the aid of a third author (L.L.). The information extracted encompassed first author, year of publication, study location, level of evidence (LOE), sample size, participant demographic data (mean age and gender), follow-up durations, surgical techniques, and rehabilitation protocols.

The primary outcomes were rates of recurrent instability and revision surgeries. Secondary outcomes encompassed operative time, number of anchors, improvements in functional scores including Rowe score, Constant-Murley score (CMS), pain level assessed by the visual analogue scale (VAS) score, range of motion (ROM) including forward flexion and external rotation, adverse events, and radiological results.

Quality assessment

Two researchers (C.W., and M.D.) assessed the methodological quality of the selected studies independently, using the revised Cochrane Risk of Bias 2 (RoB2) tool for

RCTs [38] and the Methodological Index for Non-Randomized Studies (MINORS) for cohort studies [39]. Each RCT was assessed across five domains of bias: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Each domain was rated as "low risk," "unclear risk," or "high risk." A study was classified as "poor" if any domain was rated as high risk, "excellent" if all domains were low risk, or "good" if no high risk but at least one domain was unclear risk. MINORS scores were categorized as follows: 0–8 (poor), 9–12 (good), and 13–16 (excellent). When differences arose among the researchers, a third investigator (L.L.) was brought in to make the final decision.

Statistical analysis

Statistical analyses were conducted using Review Manager V.5.4.1 (The Cochrane Collaboration, Software Update, Oxford, UK). For the meta-analysis, only data from RCTs were pooled to estimate the Weighted Mean Difference (WMD) for continuous variables and the pooled Odds Ratio (OR) for dichotomous variables, with associated 95% Confidence Intervals (CIs). Heterogeneity among RCTs was quantified using Cochrane's Q statistic and I^2 statistic, with an I^2 value < 50% considered indicative of low heterogeneity, prompting the use of a fixed-effects model, and an I^2 value > 50% leading to a random-effects model. For outcomes where pooling was not feasible due to limited RCT data or inclusion of cohort studies, results from individual studies were reported separately. Forest plots were generated to visualize pooled effect sizes from RCTs. Statistical significance was defined as $P < 0.05$.

Results

Characteristics of the included studies

Initially, the search across PubMed, EMBASE, Scopus, The Cochrane Library, and Web of Science resulted in 56 studies. From this pool, 26 duplications were removed, leaving 30 publications for title and abstract screening. This screening further brought the count down to 16 after disregarding 14 studies for full text and reference review. Seven studies were subsequently excluded, culminating in a final inclusion of nine studies. These comprised of three RCTs [34–36], two prospective cohort studies [40, 41], and four retrospective cohort studies [42–45], including 729 patients (Fig. 1). Table 1 presents the characteristics of these patients.

The knotless group had 349 patients (shoulders), while the knotted group included 380 patients (shoulders). The mean age of the knotless group was 25.3 ± 10.2 years, and the knotted group was 26.1 ± 9.7 years ($P = 0.85$). The knotless group comprised 282 males and 67 females (80.8% male), whereas the knotted group included 317 males and 63 females (83.4% male) ($P = 0.36$). The mean follow-up period for the knotless group was 31.5 ± 12.8 months, and for the knotted group, it was 36.6 ± 15.9 months ($P = 0.10$). Surgical details and rehabilitation protocols from the selected studies are shown in Table 2.

Quality assessment

The quality of the included RCTs was evaluated employing the revised ROB-2 tool, as illustrated in Fig. 2. The three RCTs were classified as one [34] excellent and two good [35, 36]. We assessed the quality of the cohort studies employing the MINORS criteria, the outcomes of which are shown in Table 3. The six cohort studies included four excellent [40, 41, 44, 45] and two good [42, 43].

Pooled outcomes from RCTs

Three RCTs involving 209 patients reported postoperative re-dislocation. There was no notable difference between the knotless group (4/103, 3.9%) and the knotted group (5/106, 4.7%) (OR, 0.83; 95% CI, 0.23 to 2.95; I^2=0%; $P = 0.78$) (Fig. 3).

Three RCTs involving 209 patients reported recurrent anterior subluxation and positive apprehension test. There was no notable difference between the knotless group (6/103, 5.8%) and the knotted group (5/106, 4.7%) (OR, 1.19; 95% CI, 0.34 to 4.16; I^2=0%; $P = 0.78$) (Fig. 4).

Three RCTs involving 209 patients reported revision surgery rates. There was no notable difference between the knotless group (2/103, 1.9%) and the knotted group (2/106, 1.9%) (OR, 1.08; 95% CI, 0.15 to 7.88; I^2=0%; $P = 0.94$) (Fig. 5).

Three RCTs involving 209 patients reported anchor numbers. There was no notable difference between the knotless group and the knotted group (WMD, -0.06; 95% CI, -0.17 to 0.05; I^2=0%; $P = 0.26$) (Fig. 6).

Two RCTs involving 122 patients reported Rowe score improvements. There was no notable difference between the knotless group and the knotted group (WMD, 5.00; 95% CI, -1.86 to 11.86; I^2=0%; $P = 0.15$) (Fig. 7).

Non-Pooled outcomes

Table 4 presents individual outcomes that could not be fully pooled, encompassing re-dislocation, recurrent anterior subluxation and positive apprehension, revision surgery, operative time, CMS, VAS, forward flexion, and external rotation. The data are derived from six non-RCTs [40–45] and one RCT [35].

Adverse events

Among the nine included studies, three [34, 36, 41] reported adverse events or complications associated with knotless and knotted arthroscopic Bankart repair. Lobo et al. [34] observed three complications, comprising

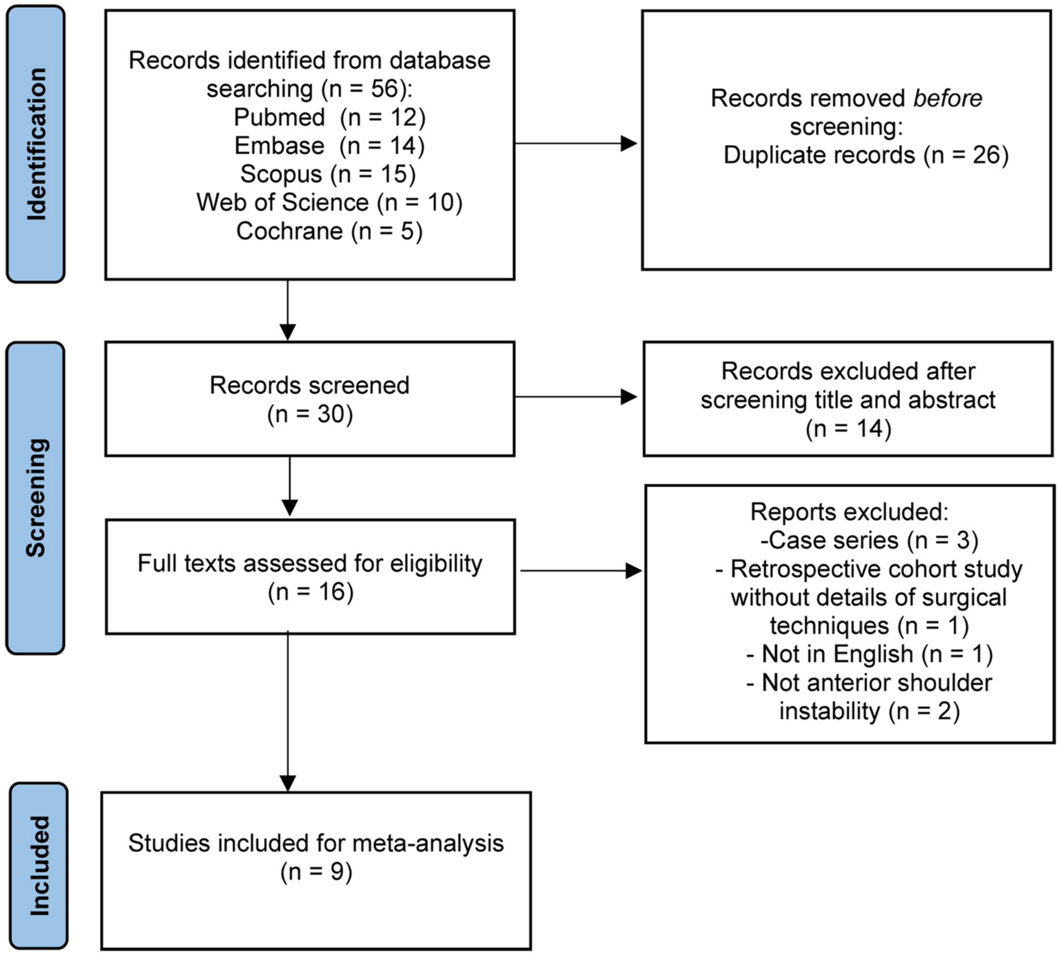

Fig. 1 PRISMA flow chart of literature retrieval

Table 1 Characteristics of the included studies

First author	Year	Country	LOE	Patients (shoulders), *n*		Age, y Mean ± SD (Range)		Sex (M/F)		Follow-up period, m Mean ± SD (Range)	
				Knotless	Knotted	Knotless	Knotted	Knotless	Knotted	Knotless	Knotted
Cho	2006	Korea	III	21 (21)	61 (61)	26 ± - (19–42)	24 ± - (16–38)	18/3	57/4	29 ± - (24–41)	
Kocaoglu	2009	Turkey	III	20 (20)	18 (18)	23 ± - (17–32)		26/12		40 ± 6 (26–56)	
Ng	2014	Singapore	II	42 (42)	45 (45)	21 ± - (18–31)	21.1 ± - (17–29)	37/5	40/5	32.4 ± - (24-44.4)	
Wu	2020	USA	III	34 (34)	68 (68)	22.7 ± 9.8	22.4 ± 9.6	30/4	59/9	57.6 ± 30	
Lobo	2021	Brazil	I	27 (27)	24 (24)	32.6 ± 11.1	31.2 ± 10.1	16/11	20/4	24	
Shim	2021	Korea	III	54 (54)	61 (61)	27 ± 9	26 ± 11	47/7	55/6	30 ± 6	54 ± 23
Saccomanno	2022	Italy	I	34 (34)	37 (37)	24.5 ± 12.1	27 ± 7.8	30/4	33/4	43.5 ± 6.9	45 ± 10.4
Johnson	2023	USA	III	86 (86)	36 (36)	25.69 ± 12.07	23.39 ± 8.57	60/26	31/5	24.24 ± 13.06	16.90 ± 10.53
Minkus	2024	Germany, Switzerland	III	31 (31)	30 (30)	24 ± 6.7	29 ± 8.9	25/6	21/9	24	

LOE, level of evidence; M, male; F, female; USA, the United States of America

one case of joint stiffness in each group and one case of acromioclavicular pain in the knotted group at 6 months post-operation, with all cases resolved following physical therapy. Saccomanno et al. [36] and Minkus et al. [41] reported no complications related to anchor material, design, or other adverse events. The remaining six studies did not assess adverse events as an outcome, limiting comprehensive evaluation. No instances of knot impingement or glenoid erosion, previously reported in the literature, were noted in the studies addressing this outcome.

Table 2 Surgical detail and rehabilitation protocol

First author	Positioning	Portals	Surgical details	Rehabilitation protocol
Cho	Beach chair position	Posterior, anteroinferior and anterosuperior portals.	Bankart lesion debrided; anterior glenoid decorticated. Knotless anchors: utility loop technique for tissue tension. Knot-tying anchors: bone punch, nonsliding Revo knot, and additional anchors at 4 and 3 o'clock.	Arm sling (3 weeks); passive ROM (weeks 3–6); active ROM (after week 6).
Kocaoglu	Beach chair position	Posterior, anterosuperior, and anteroinferior portals.	Labrum mobilized; glenoid decorticated. Knotless anchors: Push-lock at specific clock positions; sliding hangman knot for capsulolabral fixation. South/north shift of the inferior capsular pouch performed.	Immobilizer (2 weeks), sling (4 weeks); passive forward elevation (2 weeks), external rotation (4 weeks); muscle strengthening (6 weeks); full activities (6 months); sports (4 months).
Ng	Beach chair position	Posterior, anterosuperior, and anteroinferior portals.	Labrum mobilized; anterior glenoid neck decorticated. PushLock anchors placed at 5:30–3 o'clock (right) or 6:30–9 o'clock (left). Sliding hangman knot used for fixation.	Sling (1 week); pendulum exercises (week 1), passive ROM (week 2), active mobilization (week 3); avoid external rotation (6 weeks) and combined movements (12 weeks); no contact sports or overhead activities (5 months).
Wu	Beach chair position	Posterior portal; two anterior cannulas placed through the rotator interval.	Examination under anesthesia determined capsular shift. Knotless anchors (PushLock) and knot-tying anchors (Bio-SutureTak) placed per surgeon discretion (1 per cm of labral tear).	Sling (4–6 weeks); active and active-assisted ROM (weeks 6 onward); rotator cuff isometric exercises (6 weeks); proprioceptive and advanced strengthening (3 months); full athletic activities (6 months).
Lobo	Lateral decubitus position	Anterior, anterosuperior, and posterior portals.	Labrum mobilized and decorticated. Knotless anchors (PushLock) used with cinch stitch; SutureTak anchors inserted via anterior portal with a sliding knot. Fixation points started at 5 o'clock, progressing upward to complete labrum suturing.	Sling (30 days); passive full ROM (21 days); active assisted ROM (30 days); active resisted exercises (45 days); nonimpact sports (3 months); impact sports (5 months).
Shim	Lateral decubitus position	Anterior, anterosuperior, and posterior portals.	Labrum mobilized and decorticated. Knotless anchors (PushLock) used with cinch stitch; SutureTak anchors inserted via anterior portal with a sliding knot. Fixation points started at 5 o'clock, progressing upward to complete labrum suturing.	Sling (30 days); passive full ROM (21 days); active assisted ROM (30 days); active resisted exercises (45 days); nonimpact sports (3 months); impact sports (5 months).
Saccomanno	Lateral decubitus position	Anterior, anterosuperior, and posterior portals.	Knotless anchors and double-loaded bioabsorbable anchors were used. Surgical technique details not described.	Sling (4 weeks); Phase 1: focus on full ROM (weeks 4–8); Phase 2: strengthening (weeks 9–12); return to work or sports (4–6 months).
Johnson	Beach chair or lateral position (surgeon preference)	Posterior, anterosuperior, and anteroinferior portals.	Suture shuttle device used to shuttle suture/tape through the capsule/labral complex. Knotless anchors placed sequentially, tension verified, and standard knot-tying techniques used for fixation.	Sling/immobilizer (4 weeks); home exercise program (hand, wrist, elbow ROM, pendulums, day after surgery); physical therapy (2 weeks after surgery); passive ROM (weeks 2–6); active ROM (weeks 6–8); return to sports (4–6 months); contact sports (6 months).
Minkus	Lateral decubitus position	Posterior, anteroinferior, and anterosuperior portals.	Suture-first technique with knotless (PushLock) and all-suture (Juggerknot) anchors; FiberWire shuttled through the labrum using a cinch stitch. Drill holes at 5–6 o'clock position, with two additional anchors for refixation. Mattress stitch and sliding knot used for final fixation.	Sling in internal rotation (6 weeks); limited passive ROM (first 3 weeks: 60° flexion/abduction, 0° external rotation; following 3 weeks: 90° flexion/abduction); active ROM (week 7); muscle strengthening (after active ROM).

ROM, range of motion; PDS, polydioxanone suture; PEEK, polyether ether ketone

Radiological outcomes

Among the nine studies, only one [34] with 51 patients reported postoperative radiographic outcomes. A 24-month follow-up revealed no significant difference between the two groups in magnetic resonance imaging (MRI) parameters, including anterior and inferior labrum glenoid height index (LGHI), anterior and inferior labral slope, labial morphology, or osteolysis ($P = 0.052$, 0.115, 0.348, 0.501, 0.702, and 1.000 respectively).

Discussion

This meta-analysis evaluated nine studies involving 729 patients to compare knotless and knotted arthroscopic Bankart repair procedures for anterior shoulder instability. Pooled data from three RCTs showed no significant

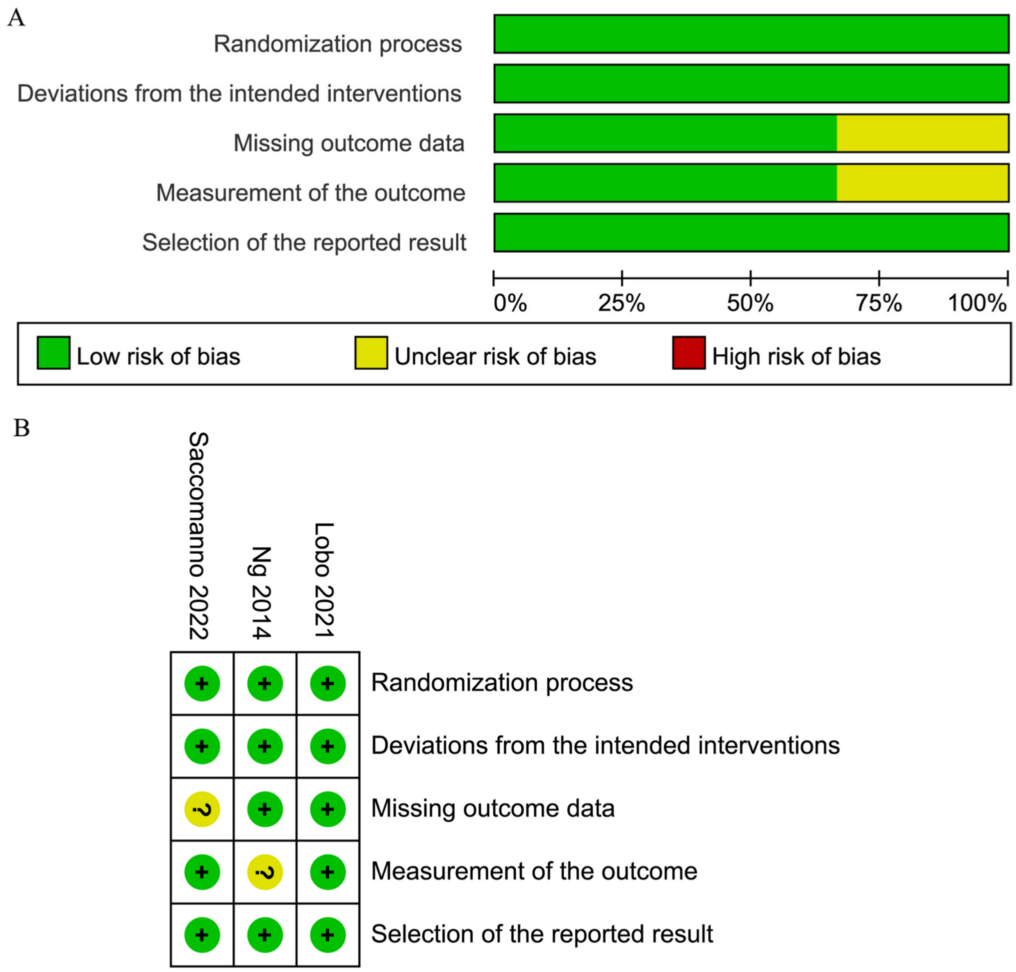

Fig. 2 Risk of bias graph (**A**) Graph of the risk of bias summary for the included studies; (**B**) Graph of the risk of bias for each included study

Table 3 Evaluation of quality in non-randomized studies using the MINORS criteria

First author	Year	Study design	A clearly stated aim	Inclusion of consecutive patients	Prospective collection of data	End points appropriate to the aim of the study	Unbiased assessment of the study end point	Follow-up period appropriate to the aim of the study	Loss to follow-up less than 5%	Prospective calculation of the study size.	Total
Cho	2006	RCS	2	2	0	2	2	2	1	0	11
Kocaoglu	2009	PCS	2	2	2	2	2	2	1	1	13
Wu	2020	RCS	2	2	0	2	2	2	1	2	13
Shim	2021	RCS	2	2	0	2	2	2	1	2	13
Johnson	2023	RCS	2	2	0	1	1	2	1	0	9
Minkus	2024	PCS	2	2	2	2	2	2	1	0	13

MINORS, Methodological Index for Non-Randomized Studies; RCS, retrospective cohort study; PCS, prospective cohort study; LOE, level of evidence. The MINORS criteria are scored as follows: 0 points if not reported, 1 point if reported but inadequate, and 2 points if reported and adequate. The highest possible score is 16

differences in re-dislocation ($P=0.78$), recurrent anterior subluxation or positive apprehension test ($P=0.78$), revision surgery ($P=0.94$), number of anchors ($P=0.26$), or Rowe score improvements ($P=0.15$). For outcomes not suitable for pooling, qualitative trends from Table 4 indicated comparable stability and functional outcomes between the two techniques, with a slightly reduced operative time in the knotless group. Adverse events were rarely reported, with comparable rates between groups. Limited radiological data from one RCT showed no notable differences in MRI parameters at 24-month follow-up.

Previous systematic reviews have explored knotless and knotted arthroscopic Bankart repairs with varying

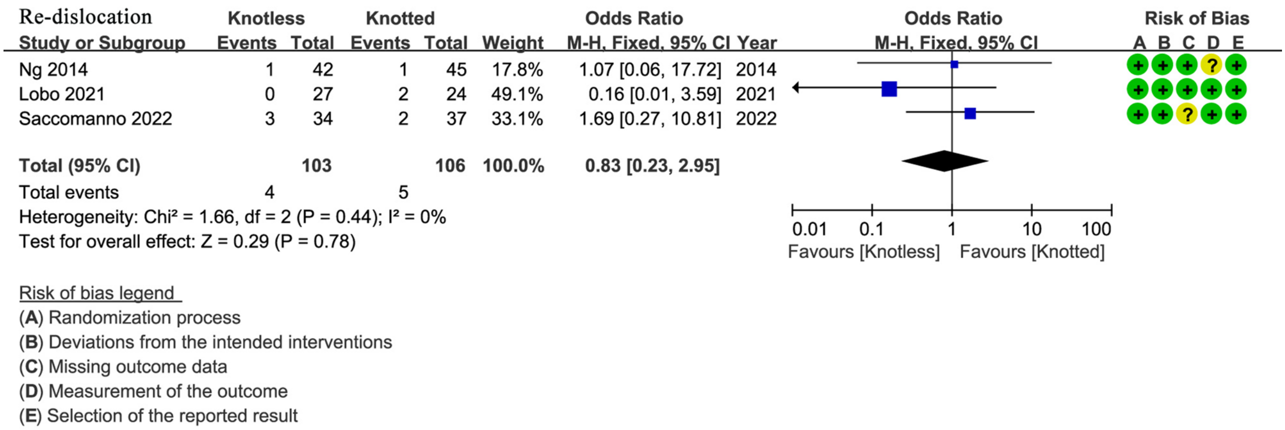

Fig. 3 Meta-analysis of rate of re-dislocation. The blue squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval, and the dimension of the square reflects the weight of each study. The black diamond represents the combined point estimate and confidence intervals

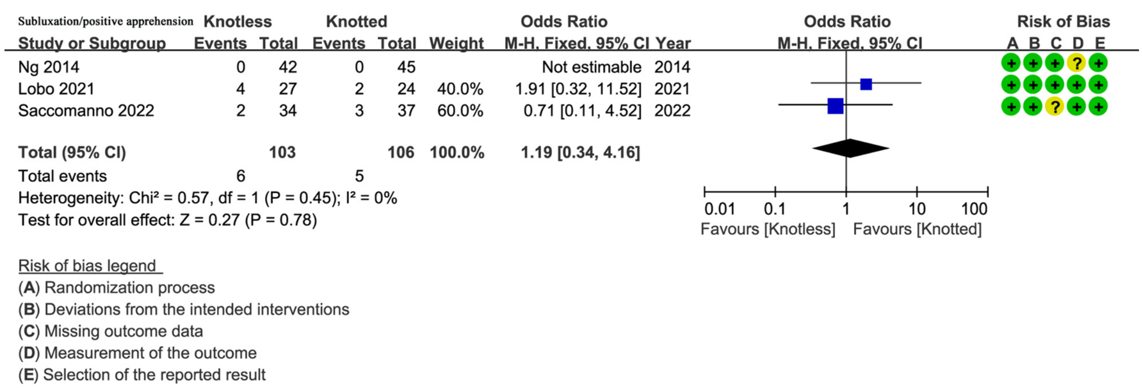

Fig. 4 Meta-analysis of rate of recurrent anterior subluxation and positive apprehension test. The blue squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval, and the dimension of the square reflects the weight of each study. The black diamond represents the combined point estimate and confidence intervals

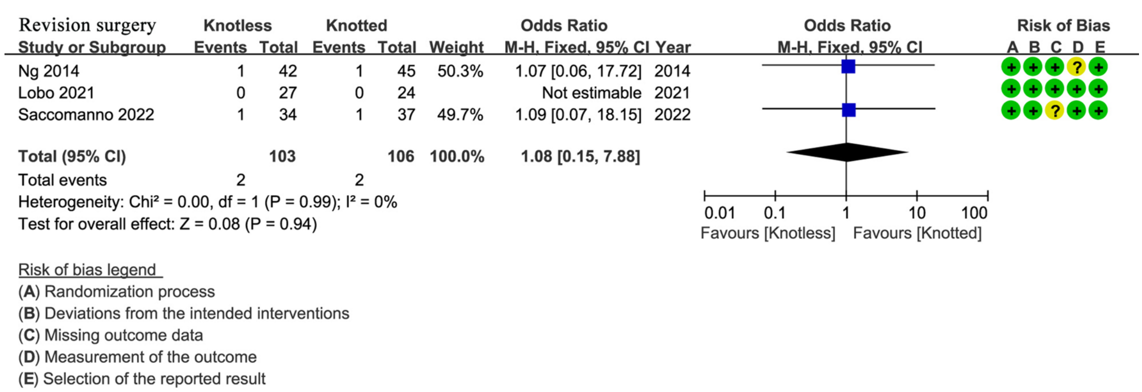

Fig. 5 Meta-analysis of rate of revision surgery. The blue squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval, and the dimension of the square reflects the weight of each study. The black diamond represents the combined point estimate and confidence intervals

focuses and limitations. Morrissey et al. [32] conducted a Level IV review of four studies with 148 patients. They compared sliding and nonsliding knot techniques, finding a slightly lower failure rate for sliding knots at 3.2% versus 4.7%. Limited evidence quality prevented firm conclusions. Matache et al. [33] performed a Level III review of four cohort studies on knotless versus knotted anchors for labral repair. They found inconclusive differences due to scarce comparative data. Mei et al. [29] conducted a Level IV review of four cohort studies and six

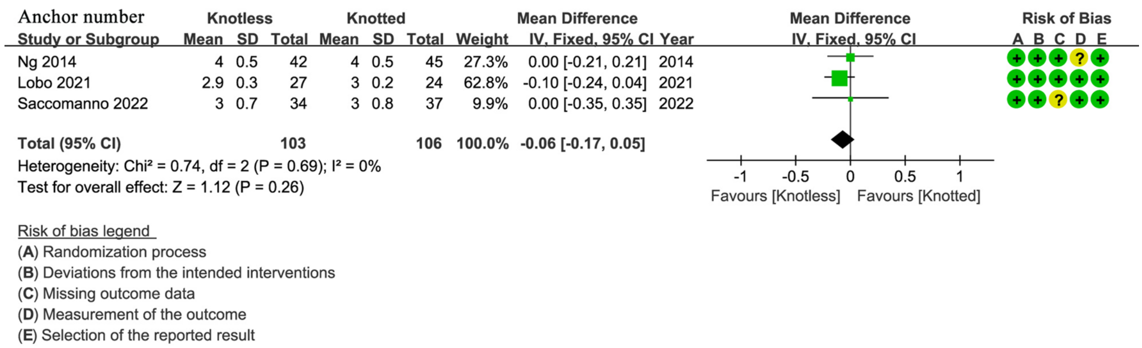

Fig. 6 Meta-analysis of anchor number. The green squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval, and the dimension of the square reflects the weight of each study. The black diamond represents the combined point estimate and confidence intervals

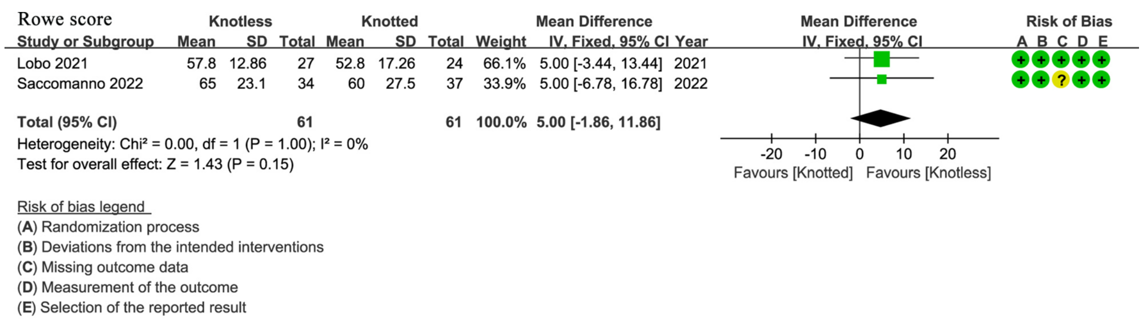

Fig. 7 Meta-analysis of improvement in Rowe score. The green squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval, and the dimension of the square reflects the weight of each study. The black diamond represents the combined point estimate and confidence intervals

case series, reporting recurrence rates from 2.2 to 14.7% for knotted repairs and 1.5–23.8% for knotless repairs. They suggested knotless repairs might be effective but noted weak evidence from non-comparative studies. These reviews struggled with insufficient direct comparisons and lower-quality evidence, preventing meta-analysis. A recent systematic review by Jain et al. [46] examined nine studies with 720 patients, finding no clear difference in clinical outcomes between techniques. Although their findings align with ours, our study employs a distinct approach. We performed the first meta-analysis of RCTs for this comparison and analyzed non-randomized studies separately for improved precision [47]. Our criteria required clear surgical technique descriptions, prompting us to exclude a database cohort study by Bents et al. [48] from Jain et al.'s review for lacking detail. With a more recent search, we also included an additional contemporary study [41], bolstering the strength and timeliness of our evidence. Biomechanical studies on knotless and knotted suture anchors for labral repairs yield varied results, with some demonstrating equivalence and others highlighting differences. Some studies [49–51] found no significant differences in first failure load, ultimate load, stiffness, or elongation between the two anchor types, while LeVasseur et al. [52] and Slabaugh et al. [53] noted comparable capsular tension restoration and labral height increases, with knotless anchors showing only minor, non-significant advantages. Conversely, Leedle and Miller [54] reported greater pullout strength for knotless anchors, Nho et al. [55] observed lower displacement loads for knotless designs despite similar ultimate loads, and Ranawat et al. [56] identified a slightly higher ultimate load for knotted anchors, though both predominantly failed at the suture-tissue interface. Sileo et al. [57] further suggested knotted anchors outperformed knotless ones in SLAP repairs for higher failure loads. Despite these biomechanical insights, our meta-analysis of clinical outcomes revealed no significant differences in redislocation rates or functional scores between knotless and knotted Bankart repairs, indicating that laboratory advantages may not translate into clinical benefits and affirming both techniques as effective options.

Biomechanical studies have identified distinct failure mechanisms for knotted and knotless suture anchors. Failures associated with knotted anchors are primarily related to knot security [55, 56]. Given the limited working space in the inferior glenoid region, consistently tying secure and well-tensioned knots during arthroscopic Bankart repair can be technically challenging [28]. Previous laboratory studies have demonstrated

Table 4 Summary of the non-pooled outcomes

Study	LOE	Knotless group	Knotted group	P
Re-dislocation				
Cho	III	5/21 (23.8%)	3/61 (4.9%)	0.012
Kocaoglu	III	1/20 (5%)	1/18 (5.6%)	NR
Wu	III	3/34 (8.8%)	10/68 (14.7%)	NR
Shim	III	4/54 (7.4%)	6/61 (9.8%)	0.710
Johnson	III	15/86 (17.4%)	4/36 (11.1%)	0.379
Minkus	III	1/31 (3.2%)	5/30 (16.7%)	0.041
Recurrent anterior subluxation and positive apprehension test				
Kocaoglu	III	0/20 (0%)	0/18 (0%)	NR
Wu	III	10/34 (29.4%)	24/68 (35.3%)	NR
Shim	III	12/54 (22.2%)	11/61 (18.0%)	0.415
Revision surgery				
Cho	III	4/21 (16.7%)	1/61 (1.6%)	NR
Kocaoglu	III	1/20 (5.0%)	1/18 (5.6%)	NR
Wu	III	1/34 (2.9%)	12/68 (17.6%)	NR
Shim	III	2/54 (3.7%)	3/61 (4.9%)	NR
Johnson	III	9/86 (10.5%)	3/36 (8.3%)	0.379
Minkus	III	1/31 (3.2%)	4/30 (13.3%)	NR
Operative time (minutes)				
Ng	II	65 ± 12, *n* = 42	74 ± 14, *n* = 45	0.325
Shim	III	60 ± 14, *n* = 54	64 ± 15, *n* = 61	0.195
Johnson	III	89.86 ± 21.09, *n* = 86	112.64 ± 25.41, *n* = 36	< 0.001
Improvement of CMS				
Cho	III	20 ± 11, *n* = 21	29 ± 7, *n* = 61	NR
Ng	II	27 ± 8, *n* = 42	28 ± 9, *n* = 45	NR
Reduction of VAS				
Cho	III	1.5 ± 2.7, *n* = 21	1.9 ± 2.1, *n* = 61	NR
Ng	II	1.9 ± 2.3, *n* = 42	1.8 ± 2.1, *n* = 45	NR
Shim	III	2.5 ± 5.2, *n* = 54	3.3 ± 2.7, *n* = 54	NR
Improvement of forward flexion				
Cho	III	4 ± 5.6, *n* = 21	1 ± 5.6, *n* = 61	NR
Ng	II	3 ± 3.8, *n* = 42	2 ± 3.5, *n* = 45	0.576
Shim	III	1 ± 6.4, *n* = 54	3 ± 8.4, *n* = 54	NR
Improvement of external rotation				
Cho	III	-4 ± 13.8, *n* = 21	-4 ± 12.1, *n* = 61	NR
Ng	II	-4 ± 12, *n* = 42	-3 ± 10, *n* = 45	0.647
Shim	III	-3 ± 11.8, *n* = 54	-1 ± 19.7, *n* = 54	NR

LOE, level of evidence; NR, not reported

considerable variability in the mechanical strength of arthroscopic knots, depending on the knot type and the surgeon technique [58]. In comparison, knotless anchors most commonly fail due to suture pull-through. Despite these biomechanical differences, the findings of this meta-analysis showed no significant difference in clinical outcomes, including rates of recurrent instability and revision surgery, suggesting similar clinical reliability between the two techniques. The knotless technique has been suggested to reduce the risk of knot-related complications such as knot migration and impingement, which may potentially cause cartilage damage to the glenoid or humeral head [16, 30, 32, 33]. However, none of the included studies reported such complications in either group. Furthermore, the only study that performed postoperative MRI found no signs of knot impingement in either the knotted or knotless group. While knot-related complications have been occasionally reported in procedures involving the rotator cuff or SLAP lesions [10, 11, 13–15], there is insufficient evidence to suggest that such complications occur following arthroscopic Bankart repair. Based on the current results and available literature, the knotless technique does not appear to provide a clear advantage in terms of reducing postoperative complications.

The only potential advantage identified in this study was that the knotless technique may lead to a slightly shorter surgical duration compared to the knotted technique, with an average difference of about 10 min based on non-pooled operative time data. Although this reduction appears modest, its clinical significance remains uncertain, as previous studies have associated increased risks of complications, such as surgical site infection and venous thromboembolism, with operative time increases of 15 min or more [59, 60]. Interestingly, a 2019 retrospective cohort study comparing knotless and knotted double-row arthroscopic rotator cuff repairs reported that, despite higher implant costs in the knotless group, the total surgical cost was significantly lower due to reduced operative time [61]. This suggests that time saving may lead to overall cost benefits. While current evidence does not demonstrate a clear clinical outcome advantage or a consistent reduction in surgical duration and associated risks for the knotless technique, we consider that its lower technical complexity may help less experienced surgeons save operative time, particularly in procedures that extend beyond a standard Bankart repair. Therefore, the choice between knotted and knotless techniques may be best guided by surgeon experience, familiarity with the technique, case-specific requirements, and cost considerations, rather than by any demonstrated clinical superiority of one method over the other.

This study has several limitations. First, the number of eligible studies was limited due to the strict inclusion criteria requiring direct comparisons between knotted and knotless techniques. Second, not all included studies were RCTs, resulting in an overall level of evidence of III. Moreover, not all studies achieved an excellent quality rating, with some studies limited by methodological constraints, which to some extent undermines the reliability of the overall evidence quality. Third, although baseline characteristics were generally comparable, differences in factors such as preoperative glenoid bone loss, surgical experience, rehabilitation protocols, and follow-up durations were unavoidable. In addition, the use of the Remplissage procedure varied among studies, which may limit the applicability of the results to isolated Bankart repair. Specifically, two studies [41, 44] explicitly reported performing Remplissage in cases with significant Hill-Sachs lesions, one study [34] confirmed its absence, and the remaining six studies [35, 36, 40, 42, 43, 45] did not clarify whether Remplissage was used. Although no adverse events were reported in the included studies, complications such as knot impingement and glenoid erosion have been documented in previous literature [10, 11, 16]. The absence of reported events in this review may reflect incomplete reporting or insufficient follow-up rather than a true absence of complications. Only one study reported radiographic outcomes at 24 months, and only one had a follow-up exceeding four years, which is considered the minimum duration for evaluating the effectiveness of arthroscopic Bankart repair [62]. Last, some cohort studies were assessed as having a high risk of bias in some domains, which may affect the reliability of the non-pooled results. More high-quality studies with longer follow-up are needed to validate these findings.

Conclusions

Both techniques demonstrate comparable shoulder stability, revision surgery rates, number of anchors used, improvements in pain and function, ROM, adverse events, and limited radiological outcomes at 24-month follow-up. The only potential advantage of the knotless technique is a possible reduction in operative time, though its clinical significance remains uncertain. Given the limitations of small sample sizes, variable evidence quality, and predominantly short-term follow-up, these findings should be interpreted cautiously. Further high-quality, long-term studies are needed to substantiate these findings.

Abbreviations

RCTs	Randomized controlled trials
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RoB2	Revised Cochrane Risk of Bias 2
MINORS	Methodological Index for Non-Randomized Studies
WMD	Weighted mean difference
OR	Odds ratio
Cis	Confidence intervals
ASES	American Shoulder and Elbow Surgeons
VAS	Visual analogue scale
ROM	Range of motion
MRI	Magnetic resonance imaging
LGHI	Labrum glenoid height index
SLAP	Superior labrum anterior to posterior lesions
LOE	Level of evidence
M/F	Male/Female
PEEK	Polyether ether ketone
RCS	Retrospective cohort study
PCS	Prospective cohort study

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-025-08832-4.

Supplementary Material 1

Author contributions

L.L. conceived the idea; C.W. screened the literature, extracted data, assessed the methodological quality of the enrolled studies, and performed the data analyses; Y.L., M.D., S.W., K.L., and Z.T.: prepared the tables and figures. All authors contributed to the writing and revisions.

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Data availability

Data for this systematic review and meta-analysis were derived from previously published studies. The new data generated from the secondary analysis are available from the corresponding author upon reasonable request.

Declarations

Ethical approval

Not applicable.

Consent to participate

Not applicable.

Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. DeFroda S, Bokshan S, Stern E, Sullivan K, Owens BD. Arthroscopic Bankart repair for the management of anterior shoulder instability: indications and outcomes. Curr Rev Musculoskelet Med. 2017;10(4):442–51. https://doi.org/10.1007/s12178-017-9435-2.
2. Owens BD, Harrast JJ, Hurwitz SR, Thompson TL, Wolf JM. Surgical trends in Bankart repair: an analysis of data from the American board of orthopaedic surgery certification examination. Am J Sports Med. 2011;39(9):1865–9. https://doi.org/10.1177/0363546511406869.
3. Aboalata M, Plath JE, Seppel G, Juretzko J, Vogt S, Imhoff AB. Results of arthroscopic Bankart repair for Anterior-Inferior shoulder instability at 13-Year Follow-up. Am J Sports Med. 2017;45(4):782–7. https://doi.org/10.1177/0363546516675145.
4. Egger AC, Willimon SC, Busch MT, Broida S, Perkins CA. Arthroscopic Bankart repair for adolescent anterior shoulder instability: clinical and imaging predictors of revision surgery and recurrent subjective instability. Am J Sports Med. 2023;51(4):877–84. https://doi.org/10.1177/03635465231151250.
5. Kim YK, Cho SH, Son WS, Moon SH. Arthroscopic repair of small and medium-sized bony Bankart lesions. Am J Sports Med. 2014;42(1):86–94. https://doi.org/10.1177/0363546513509062.
6. Cho NS, Hwang JC, Rhee YG. Arthroscopic stabilization in anterior shoulder instability: collision athletes versus noncollision athletes. Arthroscopy. 2006;22(9):947–53. https://doi.org/10.1016/j.arthro.2006.05.015.
7. Ide J, Maeda S, Takagi K. Arthroscopic Bankart repair using suture anchors in athletes: patient selection and postoperative sports activity. Am J Sports Med. 2004;32(8):1899–905. https://doi.org/10.1177/0363546504265264.

8. Mazzocca AD, Brown FM Jr., Carreira DS, Hayden J, Romeo AA. Arthroscopic anterior shoulder stabilization of collision and contact athletes. Am J Sports Med. 2005;33(1):52–60. https://doi.org/10.1177/0363546504268037.
9. Rhee YG, Ha JH, Cho NS. Anterior shoulder stabilization in collision athletes: arthroscopic versus open Bankart repair. Am J Sports Med. 2006;34(6):979–85. https://doi.org/10.1177/0363546505283267.
10. Park JG, Cho NS, Kim JY, Song JH, Hong SJ, Rhee YG. Arthroscopic knot removal for failed superior labrum Anterior-Posterior repair secondary to knot-Induced pain. Am J Sports Med. 2017;45(11):2563–8. https://doi.org/10.1177/0363546517713662.
11. Rhee YG, Ha JH. Knot-induced glenoid erosion after arthroscopic fixation for unstable superior labrum anterior-posterior lesion: case report. J Shoulder Elb Surg. 2006;15(3):391–3. https://doi.org/10.1016/j.jse.2005.03.010.
12. Sun Y, Kwak JM, Kholinne E, Tan J, Koh KH, Jeon IH. Nonabsorbable suture knot on the tendon affects rotator cuff healing: A comparative study of the knots on tendon and bone in a rat model of rotator cuff tear. Am J Sports Med. 2019;47(12):2809–15. https://doi.org/10.1177/0363546519867928.
13. Hotta T, Yamashita T. Osteolysis of the inferior surface of the acromion caused by knots of the suture thread after rotator cuff repair surgery: knot impingement after rotator cuff repair. J Shoulder Elb Surg. 2010;19(8):e17–23. https://doi.org/10.1016/j.jse.2010.07.002.
14. Kim DH, Jeon JH, Choi BC, Cho CH. Knot impingement after arthroscopic rotator cuff repair mimicking infection: A case report. World J Clin Cases. 2022;10(15):5097–102. https://doi.org/10.12998/wjcc.v10.i15.5097.
15. Uchida A, Mihata T, Neo M. Subacromial bone erosion due to suture-knots in arthroscopic rotator cuff repair: A report of two cases. Asia Pac J Sports Med Arthrosc Rehabil Technol. 2019;16:30–5. https://doi.org/10.1016/j.asmart.2018.11.006.
16. Kim SH, Crater RB, Hargens AR. Movement-induced knot migration after anterior stabilization in the shoulder. Arthroscopy. 2013;29(3):485–90. https://doi.org/10.1016/j.arthro.2012.10.011.
17. Alentorn-Geli E, Álvarez-Díaz P, Doblas J, Steinbacher G, Seijas R, Ares O, et al. Return to sports after arthroscopic capsulolabral repair using knotless suture anchors for anterior shoulder instability in soccer players: minimum 5-year follow-up study. Knee Surg Sports Traumatol Arthrosc. 2016;24(2):440–6. https://doi.org/10.1007/s00167-015-3895-y.
18. Eren İ, Büyükdogan K, Yürük B, Aslan L, Birsel O, Demirhan M. Patients without re-dislocation in the short term after arthroscopic knotless Bankart repair for anterior shoulder instability May show residual apprehension and recurrence in the long term after 5 years. J Shoulder Elb Surg. 2022;31(5):978–83. https://doi.org/10.1016/j.jse.2021.10.042.
19. Garofalo R, Mocci A, Moretti B, Callari E, Di Giacomo G, Theumann N, et al. Arthroscopic treatment of anterior shoulder instability using knotless suture anchors. Arthroscopy. 2005;21(11):1283–9. https://doi.org/10.1016/j.arthro.2005.08.033.
20. Hayashida K, Yoneda M, Mizuno N, Fukushima S, Nakagawa S. Arthroscopic Bankart repair with knotless suture anchor for traumatic anterior shoulder instability: results of short-term follow-up. Arthroscopy. 2006;22(6):620–6. https://doi.org/10.1016/j.arthro.2006.03.006.
21. Kim SC, Kim HG, Na SW, Jung JS, Yoo JC. Knotless bioabsorbable anchors placed on the glenoid face for arthroscopic Bankart repair. Am J Sports Med. 2024;52(3):613–23. https://doi.org/10.1177/03635465231221723.
22. Lacheta L, Dekker TJ, Anderson N, Goldenberg B, Millett PJ. Arthroscopic knotless, tensionable All-Suture anchor Bankart repair. Arthrosc Tech. 2019;8(6):e647–53. https://doi.org/10.1016/j.eats.2019.02.010.
23. McQuivey KS, Brinkman JC, Tummala SV, Shaha JS, Tokish JM. Arthroscopic remplissage using knotless, All-Suture anchors. Arthrosc Tech. 2022;11(4):e615–21. https://doi.org/10.1016/j.eats.2021.12.015.
24. Nattfogel EA, Ranebo MC. Patients have a 15% redislocation rate after arthroscopic Bankart repair with a knotless technique. Arthrosc Sports Med Rehabil. 2024;6(1):100864. https://doi.org/10.1016/j.asmr.2023.100864.
25. Pearce SS, Horan MP, Rakowski DR, Hanson JA, Woolson TE, Millett PJ. Knotless All-Suture, soft anchor Bankart repair results in excellent patient-Reported outcomes, high patient satisfaction, and acceptable recurrent instability rates at minimum 2-Year Follow-Up. Arthroscopy. 2023;39(8):1793–9. https://doi.org/10.1016/j.arthro.2023.02.021.
26. Thal RA, Knotless Suture, Anchor. Technique for use in arthroscopic Bankart repair. Arthroscopy. 2001;17(2):213–8. https://doi.org/10.1053/jars.2001.20666.
27. Thal R, Nofziger M, Bridges M, Kim JJ. Arthroscopic Bankart repair using knotless or bioknotless suture anchors: 2- to 7-year results. Arthroscopy. 2007;23(4):367–75. https://doi.org/10.1016/j.arthro.2006.11.024.
28. Thal R. Knotless suture anchor: arthroscopic Bankart repair without tying knots. Clin Orthop Relat Res. 2001;390:42–51.
29. Mei XY, Sheth U, Abouali J. Excellent functional outcomes and low complication rates following knotless arthroscopic Bankart repair: A systematic review of clinical and Biomechanical studies. Arthrosc Sports Med Rehabil. 2021;3(3):e927–38. https://doi.org/10.1016/j.asmr.2021.01.014.
30. Knapik DM, Kolaczko JG, Gillespie RJ, Salata MJ, Voos JE. Complications and return to activity after arthroscopic repair of isolated type II SLAP lesions: A systematic review comparing knotted versus knotless suture anchors. Orthop J Sports Med. 2020;8(4):2325967120911361. https://doi.org/10.1177/2325967120911361.
31. DeFoor MT, McDermott ER, Dickens JF, Dekker TJ. No difference in recurrent instability between knotted and knotless repair techniques in arthroscopic treatment of isolated posterior labral tears: A systematic review. Arthrosc Sports Med Rehabil. 2024;6(1):100837. https://doi.org/10.1016/j.asmr.2023.100837.
32. Morrissey CD, Houck DA, Jang E, McCarty EC, Bravman JT, Seidl AJ, et al. Sliding or nonsliding arthroscopic knots for shoulder surgery: A systematic review. Orthop J Sports Med. 2020;8(4):2325967120911646. https://doi.org/10.1177/2325967120911646.
33. Matache BA, Hurley ET, Kanakamedala AC, Jazrawi LM, Virk M, Strauss EJ, et al. Knotted versus knotless anchors for labral repair in the shoulder: A systematic review. Arthroscopy. 2021;37(4):1314–21. https://doi.org/10.1016/j.arthro.2020.11.056.
34. Lobo FL, Conforto Gracitelli ME, Malavolta EA, Leão RV, Andrade ESFB, Assunção JH, et al. No clinical or radiographic difference seen in arthroscopic Bankart repair with knotted versus knotless suture anchors: A randomized controlled trial at Short-Term Follow-Up. Arthroscopy. 2022;38(6):1812–23. https://doi.org/10.1016/j.arthro.2021.12.017.
35. Ng DZ, Kumar VP. Arthroscopic Bankart repair using knot-tying versus knotless suture anchors: is there a difference? Arthroscopy. 2014;30(4):422–7. https://doi.org/10.1016/j.arthro.2014.01.005.
36. Saccomanno MF, Cerciello S, Adriani M, Motta M, Megaro A, Galli S, et al. Knotless PEEK and double-loaded biodegradable suture anchors ensure comparable clinical outcomes in the arthroscopic treatment of traumatic anterior shoulder instability: a prospective randomized study. Knee Surg Sports Traumatol Arthrosc. 2022;30(11):3835–41. https://doi.org/10.1007/s00167-022-06969-6.
37. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ. 2009;339:b2700. https://doi.org/10.1136/bmj.b2700.
38. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898. https://doi.org/10.1136/bmj.l4898.
39. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (minors): development and validation of a new instrument. ANZ J Surg. 2003;73(9):712–6. https://doi.org/10.1046/j.1445-2197.2003.02748.x.
40. Kocaoglu B, Guven O, Nalbantoglu U, Aydin N, Haklar U. No difference between knotless sutures and suture anchors in arthroscopic repair of Bankart lesions in collision athletes. Knee Surg Sports Traumatol Arthrosc. 2009;17(7):844–9. https://doi.org/10.1007/s00167-009-0811-3.
41. Minkus M, Aigner A, Wolke J, Scheibel M. All-Suture anchor vs. Knotless suture anchor for the treatment of anterior shoulder Instability-A prospective cohort study. J Clin Med. 2024;13(5). https://doi.org/10.3390/jcm13051381.
42. Cho NS, Lubis AM, Ha JH, Rhee YG. Clinical results of arthroscopic Bankart repair with knot-tying and knotless suture anchors. Arthroscopy. 2006;22(12):1276–82. https://doi.org/10.1016/j.arthro.2006.07.005.
43. Johnson AH, Brennan JC, Lashgari CJ, Petre BM, Turcotte JJ, Redziniak DE. Clinical results of Knot-tying versus knotless suture anchors in arthroscopic anteroinferior labral repair. Cureus. 2023;15(6):e40292. https://doi.org/10.7759/cureus.40292.
44. Shim JW, Jung TW, Kim IS, Yoo JC. Knot-Tying versus knotless suture anchors for arthroscopic Bankart repair: A comparative study. Yonsei Med J. 2021;62(8):743–9. https://doi.org/10.3349/ymj.2021.62.8.743.
45. Wu IT, Desai VS, Mangold DR, Camp CL, Barlow JD, Sanchez-Sotelo J, et al. Comparable clinical outcomes using knotless and knot-tying anchors for arthroscopic capsulolabral repair in recurrent anterior glenohumeral instability at mean 5-year follow-up. Knee Surg Sports Traumatol Arthrosc. 2020;29(7):2077–84. https://doi.org/10.1007/s00167-020-06057-7.

46. Jain G, Datt R, Krishna A, Patro BP, Morankar R. No clear difference in clinical outcomes between knotted and knotless arthroscopic Bankart repair: A systematic review. Arthroscopy. 2024. https://doi.org/10.1016/j.arthro.2024.05.036.
47. Lubowitz JH, Cote MP. Meta-analysis of nonrandomized controlled trials is rarely justified: systematic reviews must avoid improper pooling. Arthroscopy. 2025;41(2):155–9. https://doi.org/10.1016/j.arthro.2024.09.039.
48. Bents EJ, Brady PC, Adams CR, Tokish JM, Higgins LD, Denard PJ. Patient-Reported outcomes of knotted and knotless glenohumeral labral repairs are equivalent. Am J Orthop (Belle Mead NJ). 2017;46(6):279–83.
49. Lacheta L, Brady A, Rosenberg SI, Dornan GJ, Dekker TJ, Anderson N, et al. Biomechanical evaluation of knotless and knotted All-Suture anchor repair constructs in 4 Bankart repair configurations. Arthroscopy. 2020;36(6):1523–32. https://doi.org/10.1016/j.arthro.2020.01.046.
50. Martetschläger F, Michalski MP, Jansson KS, Wijdicks CA, Millett PJ. Biomechanical evaluation of knotless anterior and posterior Bankart repairs. Knee Surg Sports Traumatol Arthrosc. 2014;22(9):2228–36. https://doi.org/10.1007/s00167-013-2602-0.
51. Yanke AB, Allahabadi S, Wang Z, Credille KT, Shewman E, Bonadiman JA, et al. Biomechanical analysis of anteroinferior Bankart repair anchor types. Am J Sports Med. 2023;51(10):2642–9. https://doi.org/10.1177/03635465231180621.
52. LeVasseur MR, Mancini MR, Williams N, Obopilwe E, Cote MP, Coyner KJ, et al. Ability to retension knotless suture anchors: A Biomechanical analysis of simulated Bankart lesions. Orthop J Sports Med. 2022;10(6):23259671221098726. https://doi.org/10.1177/23259671221098726.
53. Slabaugh MA, Friel NA, Wang VM, Cole BJ. Restoring the labral height for treatment of Bankart lesions: a comparison of suture anchor constructs. Arthroscopy. 2010;26(5):587–91. https://doi.org/10.1016/j.arthro.2009.09.010.
54. Leedle BP, Miller MD. Pullout strength of knotless suture anchors. Arthroscopy. 2005;21(1):81–5. https://doi.org/10.1016/j.arthro.2004.08.011.
55. Nho SJ, Frank RM, Van Thiel GS, Wang FC, Wang VM, Provencher MT, et al. A Biomechanical analysis of anterior Bankart repair using suture anchors. Am J Sports Med. 2010;38(7):1405–12. https://doi.org/10.1177/0363546509359069.
56. Ranawat AS, Golish SR, Miller MD, Caldwell PE 3rd, Singanamala N, Treme G, et al. Modes of failure of knotted and knotless suture anchors in an arthroscopic Bankart repair model with the capsulolabral tissues intact. Am J Orthop (Belle Mead NJ). 2011;40(3):134–8.
57. Sileo MJ, Lee SJ, Kremenic IJ, Orishimo K, Ben-Avi S, McHugh M, et al. Biomechanical comparison of a knotless suture anchor with standard suture anchor in the repair of type II SLAP tears. Arthroscopy. 2009;25(4):348–54. https://doi.org/10.1016/j.arthro.2008.10.019.
58. Hanypsiak BT, DeLong JM, Simmons L, Lowe W, Burkhart S. Knot strength varies widely among expert arthroscopists. Am J Sports Med. 2014;42(8):1978–84. https://doi.org/10.1177/0363546514535554.
59. Agarwalla A, Gowd AK, Yao K, Bohl DD, Amin NH, Verma NN, et al. A 15-Minute incremental increase in operative duration is associated with an additional risk of complications within 30 days after arthroscopic rotator cuff repair. Orthop J Sports Med. 2019;7(7):2325967119860752. https://doi.org/10.1177/2325967119860752.
60. Boddapati V, Fu MC, Schairer WW, Ranawat AS, Dines DM, Taylor SA, et al. Increased shoulder arthroscopy time is associated with overnight hospital stay and surgical site infection. Arthroscopy. 2018;34(2):363–8. https://doi.org/10.1016/j.arthro.2017.08.243.
61. Burns KA, Robbins L, LeMarr AR, Childress AL, Morton DJ, Wilson ML. Rotator cuff repair with knotless technique is quicker and more Cost-Effective than knotted technique. Arthrosc Sports Med Rehabil. 2019;1(2):e123–30. https://doi.org/10.1016/j.asmr.2019.09.005.
62. Rossi LA, Pasqualini I, Huespe I, Brandariz R, Fieiras C, Tanoira I, et al. A 2-Year Follow-up May not be enough to accurately evaluate recurrences after arthroscopic Bankart repair: A Long-term assessment of 272 patients with a mean Follow-up of 10.5 years. Am J Sports Med. 2023;51(2):316–22. https://doi.org/10.1177/03635465221139290.

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