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Shoulder arthroplasty to address the sequelae of anterior instability arthropathy and stabilization procedures: systematic review and meta-analysis

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Abstract

Purpose Chronic anterior glenohumeral joint instability is a common situation and can lead to progressive cartilage deterioration and ultimately instability arthopathy. Progressive cartilage deterioration can occur despite conservative or surgical treatment and the sequelae of these conditions are often addressed with total shoulder arthroplasty. Aims of the present study were to analyze the available literature to describe the technical aspects of this particular operation and to report outcomes and complication rates. The hypothesis was that shoulder arthropalsty in the sequelae of instability had lower outcomes and higher complication rates than arthroplasties for primary arthritis.

Methods A systematic review of the literature was performed, in accordance with the PRISMA guidelines. PubMed, Ovid, Cochrane Reviews, and Google Scholar were comprehensively searched using a combination of the following keywords: shoulder arthroplasty, reverse shoulder arthroplasty, dislocation arthropathy, capsulorrhaphy arthropathy and stabilization procedures.

Results Thirteen studies with 365 patients met inclusion criteria. Since 13 patients were lost to follow-up, 352 were reviewed at an average follow-up of 53.4 months. The average Constant–Murley (CM) and American Shoulder and Elbow Society (ASES) scores improved from 35.6 and 35.7 to 72.7 and 77, respectively. The overall complication rate was 25.7% and the reoperation rate was 18.5%. Radiographs at follow-up revealed radiolucent lines on the humerus in 12.4% of cases and radiolucent lines or notching on the glenoid side in 22.7% of cases. The average Methodological Index for Non-randomized Studies Score (MINORS) was 12.9 for non-comparative studies and 21.3 for comparative studies.

Conclusion Shoulder arthroplasty to address the sequelae of instability arthropathy and stabilization procedures can be a challenging procedure as a consequence of the distorted anatomy and severe glenohumeral joint pathology. Complication and reoperation rates are higher compared to shoulder arthroplasty for primary glenohumeral joint arthritis; however, the difference is not statistically significant. When reverse shoulder arthroplasties (RSA) were considered as a subgroup and compared to anatomic shoulder replacements (total shoulders and hemiarthroplasties), they showed a lower revision rate.

Keywords Anterior instability · Capsulorrhaphy arthropathy · Dislocation arthropathy · Total shoulder arthroplasty

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Introduction

Anterior glenohumeral joint instability is relatively common in orthopaedic practice, with an overall adjusted incidence of 8.2/100.000 persons [29]. After the first traumatic episode, recurrence is reported with an incidence between 0.5 and 1.7% [16]. Treatment options include conservative approach and several surgical options, including open or arthroscopic Bankart repairs (with or without capsular shifts) and bone block procedures. Satisfactory results have been described both in the case of conservative treatment and surgical approaches; however, the risk of developing late arthropathy

has been widely reported with both surgical and non-surgical treatment approaches. Prospective radiographic studies have shown clear signs of arthritis in over 20% of patients with a reported history of shoulder dislocation [17]. The risk of developing post-instability arthritis seems to be related to the pathology itself rather than the treatment option [4, 18]. According to these data, the probability of developing shoulder joint arthritis requiring arthroplasty has been shown to be ten times higher in patients with a history of shoulder dislocation compared to normal subjects [21]. Similarly the rate of shoulder joint arthritis was twenty times higher in patients who underwent surgical treatment [21]. The terms "capsulorrhaphy arthropathy," "dislocation arthropathy" or "instability arthropathy" have been used to distinguish the etiology of the glenohumeral joint arthritis that occurs after conservative or surgical treatment as compared to primary osteoarthritis [13, 22]. Total shoulder arthroplasty (TSA) and reverse TSA (rTSA) in patients with instability arthropathy presents several potential surgical challenges related often to the young age of the patients, soft-tissue contracture, and potential bone deficiency. The aims of the present systematic review and meta-analysis were to critically analyze the available literature to describe the technical aspects of this particular operation and to report outcomes and complication rates. In addition, the quality of the studies was assessed with the Methodological Index for Non-randomized Studies (MINORS) [31], which has been demonstrated as a reliable tool to determine the methodological quality of scientific studies. The hypothesis was that TSA and rTSA in the sequelae of shoulder instability had lower outcomes and higher complication rates than TSA and rTSA for primary arthritis.

Materials and methods

A systematic literature review using the following keyword terms and Boolean operators "total shoulder arthroplasty" OR "reverse shoulder arthroplasty" AND "dislocation arthropathy" OR "capsulorrhaphy arthropathy" OR "stabilization procedures" with no limit regarding the year of publication was performed in accordance with the PRISMA guidelines. The following databases were accessed on September the 8th 2018: PubMed (https://www.ncbi.nlm.nih.gov/sites/entrez/), Ovid (https://www.ovid.com), Cochrane Reviews (https://www.cochrane.org/reviews/), and Google Scholar (https://scholar.google.com). The inclusion criteria included therapeutic studies written in English. Prospective and retrospective studies reporting clinical outcomes and complications were included whereas reviews, technical notes, and case reports were excluded. Two independent surgeons screened all the titles and abstracts and the full-text of any relevant abstract was retrieved. In addition, the reference lists of all the retrieved full-texts were checked manually for any additional relevant studies that may have been missed with the first search. The initial search resulted in 542 articles and 13 studies were eligible for review of outcomes and complications and methodological assessment following screening [3, 5, 7, 8, 10, 13, 20, 22, 23, 25, 26, 32, 35] (Fig. 1).

Methodological evaluation was performed according to the MINORS evaluation [31], a tool specifically created to evaluate the quality of nonrandomized surgical studies. The checklist includes 12 items, with the last 4 specific to comparative studies. Scoring was as follows: 0, not reported; 1, reported but poorly done and/or inadequate; and 2, reported, well done and adequate. The highest overall score was 16 for non-comparative studies and 24 for comparative studies.

Statistical analysis

Data analysis was performed with Review Manager (Version 5.3, The Cochrane Collaboration). Risk ratio (RR) was used as summary statistics to perform statistical analysis of dichotomous variables. They were reported with 95% confidence intervals (95% CI), and P value of 0.05 was used as the level of statistical significance. Statistical heterogeneity between trials was evaluated by the Chi-square and I-square (I^2) test, with significance set at $P < 0.10$. An I^2 above 40% was considered indicative of heterogeneity. Fixed-effects models were used depending on the heterogeneity of the studies included. To assess publication bias, a funnel plot was constructed for each outcome to examine the relationship between sample size and the magnitude of effect. A sensitivity analysis was conducted by excluding one study in each round and evaluating the influence of any single study on the primary meta-analysis estimate.

Results

Patient demographics

Demographic data are summarized in Table 1.

The initial cohort included 365 patients having received a shoulder replacement as a sequelae of dislocation arthropathy or stabilization surgeries. The average age at the time of surgery was 56.7 years and male/female ratio was 255–110. The average delay between the initial procedure and the replacement was 20.2 years, while the average number of surgeries prior to shoulder replacement was 1.5. Total shoulder arthroplasty (TSA) was performed in 207, shoulder hemiarthroplasty (HA) in 38, humeral head replacement (HR) in 16 and reverse shoulder arthroplasty (RSA) in 91. Thirteen patients were

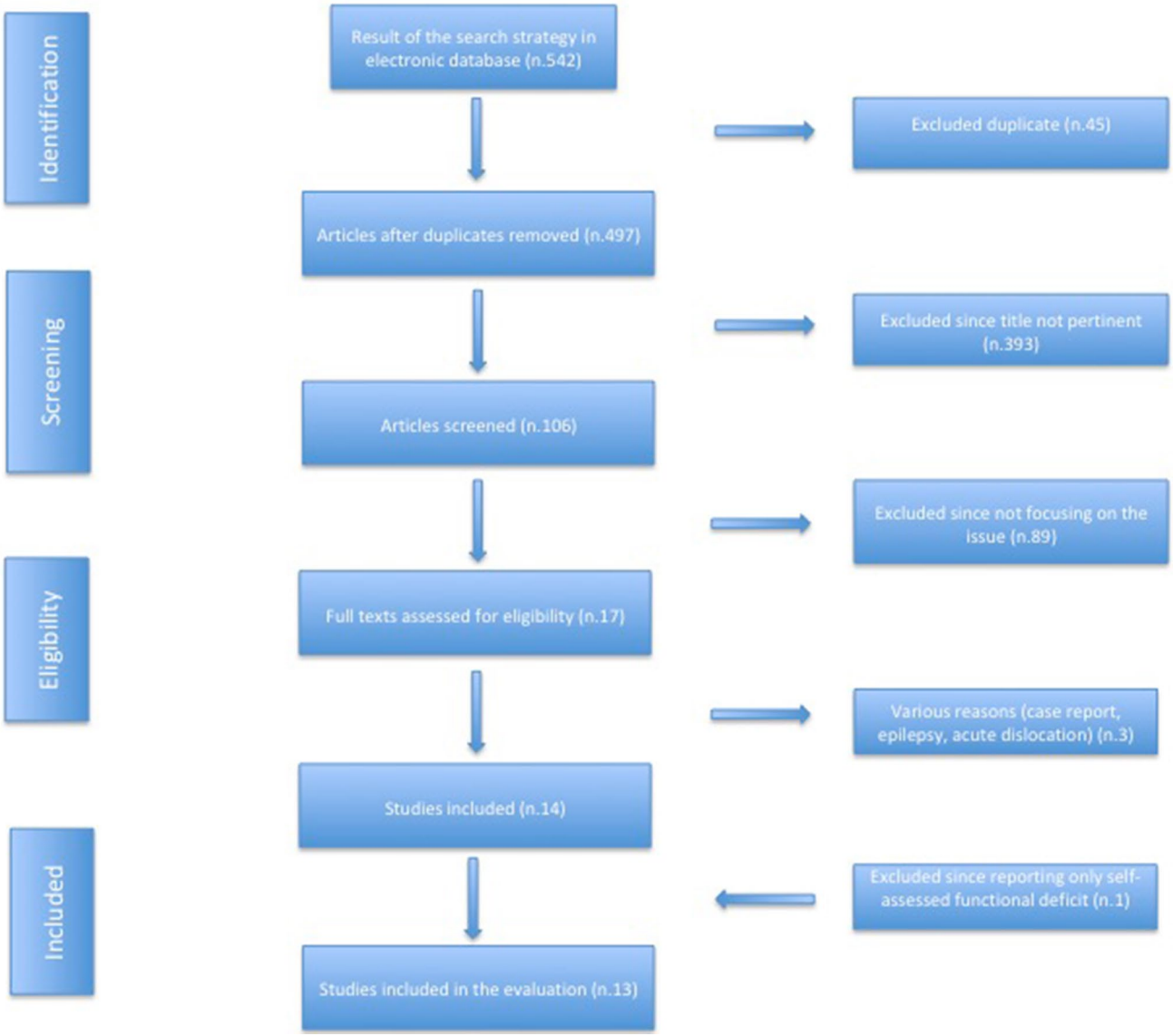

Fig. 1 Flowchart

lost to follow-up leaving 352 patients available for either clinical and/or radiological evaluation at an average follow-up of 53.4 months.

Clinical outcomes

Outcomes are summarized in Table. 2. The average Constant–Murley score, American Shoulder and Elbow Society (ASES) score and Simple Shoulder Test score improved from 35.5, 35.7 and 4.5 to 72.7, 77 and 8.5, respectively.

Methodology evaluation

The average MINORS was 12.9/16 for non-comparative studies and 21.3/24 for comparative studies.

Complications

Complications are reported in Table 2. Radiolucent lines on the humeral side were observed in 12.4% of patients. Scapular notching or radiolucent lines were observed in 22.7% of cases. However, when glenoid notching (which is not a specific complication of such peculiar procedures) was not considered, the rate of radiographic complications on the glenoid side was 19.5%. In any case, the radiographic findings were judged to be neither symptomatic nor evolutive.

Table 1 Patient demographics

Author	Year	Journal	Type of study	Initial cohort	Mean patient age (years)	Sex (M/F)	FU (months)	MINORS score
				SG/CG	SG/CG	SG/CG	SG/CG	
Neer [25]	1982	JBJSa	Case series Prospective	26	45 (19–74)	23/3	34	12/16
Bigliani [3]	1995	JSES	Case series Prospective	17	43 (26–65)	13/4	35 (18–102)	14/16
Green [13]	2001	JSES	Case series Retrospective	19	47 (30–69)	11/8	62 (24–167)	13/16
Sperling [33]	2002	JBJSa	Case series Prospective	31	46 (21–72)	25/6	84 (> 24)	14/16
Matsoukis Surg [22]	2003	JBJSa	Multicenter Prospective	27	55.9 (27–74)	16/11	45 (24–87)	14/16
Matsoukis Cons [22]	2003	JBJSa	Multicenter Prospective	28	62.2 (33–83)	15/13	45 (24–87)	14/16
Lehman [20]	2010	Int orthop	Case series Retrospective	45	55.8 (32–76)	30/15	44 (12–101)	10/16
Raiss [26]	2014	Int orthop	Case series retrospective	13	70 (48–82)	8/5	42 (24–96)	12/16
Cadet [5]	2014	JSES	Case control	22 (SG)	55 (33–83)	21/1	78 (24–132)	20/24
			Retrospective	20 (CG)	58 (33–71)	12/8	70 (24–120)	
Chalmers [7]	2017	Journal of Shoulder and Elbow Arthroplasty	Case series retrospective	24	70 (50–87)	14/10	40 (24–84)	12/16
Merolla [23]	2018	Int orthop	Case control	19 (SG)	44.5 (23–55)	12/7	52.6 (24–134)	22/24
			Retrospective	30 (CG)	48.2 (36–59)	18/12	41.6 (28–71)	
Cuff [10]	2018	Orthopedics	Case series	19 (TSA)	67.5 (58–74)	18/1	59.5 (24–110)	22/24
			retrospective	20 (RSA)	68.1 (62–74)	20/0	43.8 (24–72)	
Willemot [35]	2018	JSES	Case series retrospective	30	50.7 ± 12.8	17/13	58	14/16
Clavert [8]	2018	Int Orthop	Case series retrospective	25	69.9	12/13	78 (24–138)	14/16

JSES Journal of Shoulder and Elbow Surgery, *JBJSa* Journal of Bone and Joint Surgery American, *Int orthop* International Orthopaedics, *Surg* post instability surgery, *Cons* post conservative treatment

Reoperations were defined as all possible causes requiring further surgical procedures (including revision of the implant). Complications were defined as all intraoperative, perioperative and postoperative notable adverse events plus the reoperation cases. Reoperation rates and complication rates in the cohort of patients following shoulder arthroplasty for instability arthropathy and stabilization procedures were 18.5% and 25.7%, respectively. The same rates in the cohort of patients having a shoulder replacement for primary arthritis were 11.5 and 11.5, respectively (Table 3).

Statistical analysis of the comparative studies [5, 23] showed that there was no significant difference between the two groups (post instability cases and primary arthritis cases), and the risk ratio for complications rate was in favor of control group (95% CI 0.29 to 24.95; $P = 0.17$) ($P = 0.87$, $I^2 = 46\%$ for homogeneity) (Fig. 2) (Table 4).

When the outcomes of TSA and HA in the post instability cohort were compared [13, 23, 33], the analysis showed that there was no significant difference between the TSA and HA in the study group, and the risk ratio for the risk of revision was in favor of TSA (95% CI 0.42–2.65; $P = 0.91$) ($P = 0.11$, $I^2 = 0\%$ for homogeneity) (Fig. 3).

Anatomic replacement (TSA, HHR an HA) vs reverse prosthesis in the post instability cohort

When the outcomes and complications of anatomic replacements and reverse prostheses in the instability arthropathy and post stabilization procedure arthropathy cohort were

Table 2 Outcomes and complications of shoulder arthroplasty in the sequelae of dislocation arthopaty and stabilization procedures

Author year	No. of preop surgeries	Delay stabilization/TSA (years)	Procedure	Preop outcome	Postop outcome	RX	Compl (%)	Reop
Neer [25]	1.3	na	17 TSA	na	76.5% VS or S 23.5% US	na	5.90	0
Bigliani [3]	2.4 (2–4)	15.9 (4–45)	12 TSA 5 HA	na	77% VS or S 23% US	25% G	17.60	17.60
Green [13]	2.2	14 (13–23)	15TSA 2HR	na	71% much better 24% better 5% worse	0%	41.20	35.20
Sperling [33]	1.7	21 (0.6–51)	21 TSA 10 HA	na	45.2% VS or S 54.8% US	59.3% H 50% G	51.60	35.50
Matsoukis Surg [22]	1.1	20.1	27 (39 TSA 16 HA)	CM 35	CM 69.4 96% excellent or good results	9.1% H 38.2% G	20	12.70
Matsoukis Cons [22]	none	18.6 (1st dislocation)	28 (39 TSA 16 HA)	CM 27.3	CM 62.4 93% excellent or good results	9.1% H 38.2% G	20	12.70
Lehman [20]	1	5 (0–24)	35 TSA 10 h	CM 40.9	CM 65.7 CM	11.1% G	35.60	26.70
Raiss [26]	1.2	15 (1–49)	13 RSA	CM 26	CM 67 92% VS or S 8% US	38% G notching	8	8
Cadet [5]	1.7	26.5 (± 15.5)	22 TSA (Sg)	SST 3.9 ASES 32 SST 5.1 ASES 41	SST 8.7 ASES 73	18.1% H 9.1% G	59.10	59.10
	0.7	26.5 (± 15.5)	20 TSA (Cg)		SST 8.6 ASES 77	20% H 5% G	20	20
Chalmers [7]	na	na	24 RSA	no	92% little or no pain	0% H 16% G notching	4.20	8.40
Merolla [23]	1	15.5 (2–30)	13 TSA, 2 HA, 4 h	CM 46.3 (21.7)	CM 73.7 (15.3)	37% H 26% G	0	0
			22 TSA, 5 HA, 3 h	CM 44.4 (3.1)	CM 81 (7.3)	40% H 54% G	3.30	3.30
Cuff [10]	1.4 (1–3)	na	19 TSA	SST 4.7 ASES 37	SST 8.8 ASES 79	0% H 21% G	21	16
	1.3 (1–3)	na	20 RSA	SST 4.9 ASES 38	SST 8.0 ASES 79	0% H 5% G notching	0	10
Willemot [36]	> 1.4	19.9 (± 13.1)	14 TSA, 5 HA, 11 RSA	na	63.3% VS or S 36.7%% US	0% H 16% G	73.30	30
Clavert [8]	na	50.3 (± 13.5)	23 RSA	CM 37.9	CM 97.8	0% H 40% notching	13	8.70

Sg study group, *Cg* control group, *Surg* post instability surgery, *Cons* post conservative treatment, *TSA* total shoulder arthroplasty, *HA* hemiarthroplasty, *RSA* reverse shoulder arthroplasty, *VS* very satisfied, *S* satisfied, *US* unsatisfied, *ASES* American shoulder and elbow society score, *SST* simple shoulder test, *CM* Constant–Murley score, *H* humerus, *G* glenoid

compared interesting data emerged (Table 5). Constant Murley score and ASES score at FU were 67.8 and 75 for anatomic replacements and 82.4 and 77 for RSAs. Complications and reoperation rates were 37.3 and 22.5 in the

Table 3 Outcomes and complications of shoulder arthroplasty in the sequelae of dislocation arthropathy and stabilization procedures (SG) and primary osteoarthritis (CG)

Author	FU	Patients at FU	Score n.1 at FU (CM)	Score n.1 at FU (ASES)	Complications (%)	Reoperations	X-rays (humerus)	X-rays (glenoid)
Neer [25]	34	17	na	na	5.9%	0%	na	na
Bigliani [3]	35	17	na	na	17.6%	17.6%	0%	25%
Green [13]	62	17	na	na	41.2%	35.2%	0%	0%
Sperling [33]	84	31	na	na	51.6	35.5%	59.3%	50%
Matsoukis Caspulorrapy [22]	55	27	69.4	na	20%	12.7%	9.1%	38.2%
Matsoukis Dislocation [22]	55	28	62.4	na	20%	12.7%	9.1%	38.2%
Lehmann [20]	44	45	65.7	na	35.6%	26.7%	na	11%
Raiss [26]	42	13	67	na	8%	8%	na	38%
Cadet [5]	78	22	na	73	59.1%	59.1%	18.1%	9.1%
Chalmers [7]	40	24	na	na	8.4%	4.2%	na	16%
Merolla [23]	52.6	19	73.7	na	0	0	37%	26%
Cuff [10]	59.5	39	na	79	15.5%	8%	0%	13%
Willemot [35]	43.8	20	na	Na	73.3%	30%	0%	16%
Clavert [8]	78	23	97.8	Na	13%	8.7%	0%	40%
Average (SG)	54.2	322	72.7	77	25.7%	18.5%	12.4%	22.7%
Cadet [5]	70	20	na	77	20%	20%	20%	5%
Merolla [23]	41.6	30	81	na	3%	3%	40%	54%
Average (CG)	55.8	50	81	77	11.5%	11.5%	30	29.5%

SG study group (shoulder arthroplasty in the sequelae of dislocation arthropaty and stabilization procedures), *CG* control group (shoulder arthroplasty in for primary arthritis)

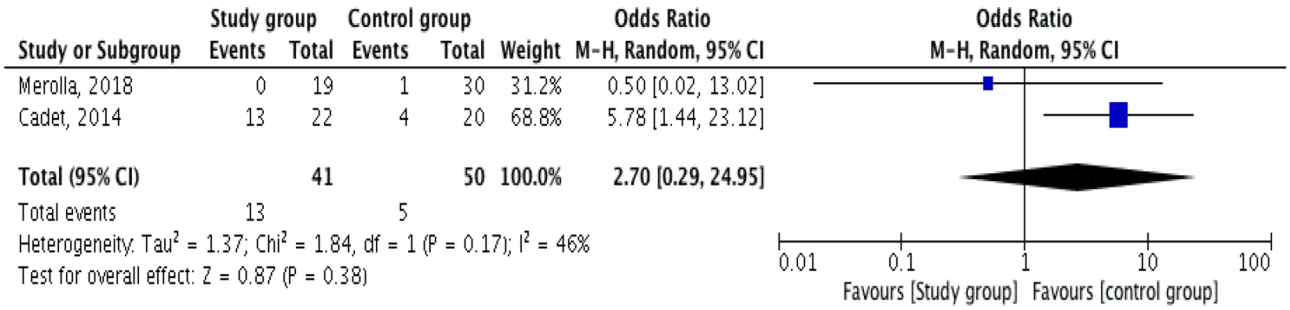

Fig. 2 A fixed-effects meta-analysis that compares the complication rate between study and control groups

Table 4 Outcomes and complications of comparative studies (SG vs CG)

Author	FU	Patients at FU	Score n.1 at FU (CM)	Score n.2 at FU (ASES)	Complications	Reoperations	X-rays (humerus)	X-rays (glenoid)
Cadet [5]	78	22	na	73	59.1%	59.1%	18.1%	9.8%
Merolla [23]	52.6	19	73.7	na	0	0	37%	26%
Average (SG)	65.3	41	73.7	73	29.5%	29.5%	27.5%	17.9%
Cadet [5]	70	20	na	77	20%	20%	20%	5%
Merolla [23]	41.6	30	81	na	3%	3%	40%	54%
Average (CG)	55.8	50	81	77	11.5%	11.5%	30	29.5%

SG study group (shoulder arthroplasty in the sequelae of dislocation arthropathy and stabilization procedures), *CG* control group (shoulder arthroplasty in for primary arthritis)

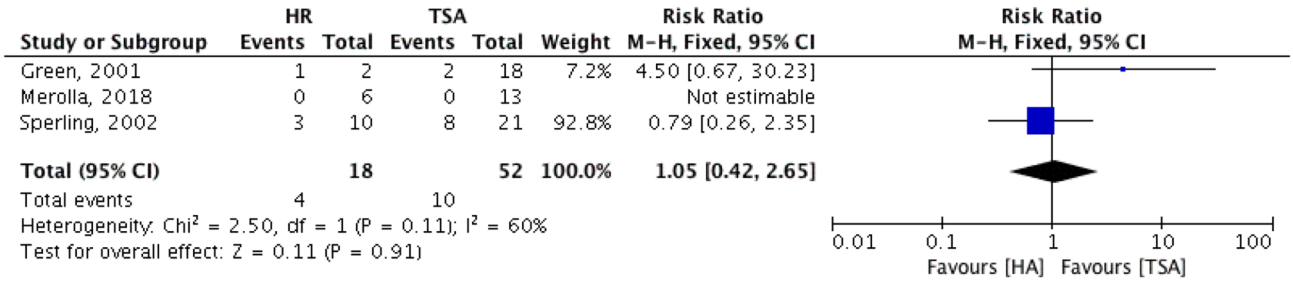

Fig. 3 A fixed-effects meta-analysis that compares the relative risk of revision in HR and TSA in the study group (SR secondary to instability surgery)

Table 5 Outcomes and complications of anatomic replacements (Ars) (including TSA, HHR and HA) and RSA in the cohort of patients with dislocation arthropathy and stabilization surgeries

Author	FU	Patients at FU	Score n.1 at FU (CM)	Score n.1 at FU (ASES)	Complications	Reoperations	X-rays (humerus)	X-rays (glenoid)
Neer [25]	34	17	na	na	5.9%	0%	na	Na
Bigliani [3]	35	17	na	na	17.6%	17.6%	0%	25%
Green [13]	62	17	na	na	41.2%	35.2%	0%	0%
Sperling [33]	84	31	na	na	51.6%	35.5%	59.3%	50%
Matsoukis Caspulorrapy [22]	55	27	69.4	na	20%	12.7%	38.2%	9.1%
Matsoukis Dislocation [22]	55	28	62.4		20%	12.7%	38.2%	9.1%
Lehmann [20]	44	45	65.7	na	35.6%	26.7%	na	11%
Cadet [5]	78	22	na	73	59.1%	59.1%	18.1%	9.1%
Merolla [23]	52.6	19	73.7	na	0	0	37%	26%
Cuff [10]	59.5	19	na	79	21%	16%	0%	13%
Average (ARs)	55.9	242	67.8	75	37.3%	22.5%	21.8%	17.9%
Raiss [26]	42	13	67	na	8%	8%	na	38%
Chalmers [7]	40	24	na	na	8.4%	4.2%	na	16%
Cuff [10]	59.5	20	na	79	10%	0%	0%	5%
Clavert [8]	78	23	97.8	na	13%	8.7%	0%	40%
Average (RSA)	53.3	80	82.4	77	9.8%	5.2%	0%	24.7%

ARs anatomic replacements including TSA (total shoulder arthroplasty), HHR (humeral head replacement) and HA (hemiarthroplasty), *RSA* reverse shoulder arthroplasty

anatomic replacement cohort and 9.8 and 5.2 in the RSAs cohort. Lucent lines on the humerus were 21.8% (anatomic replacements) and 0% (RSAs) while on the glenoid side were 17.9 and 24.7, respectively.

Discussion

The present study has several notable findings. First of all, when considering comparative studies, a trend toward high complication and reoperation rates were observed in the group of patients having a shoulder arthroplasty in the sequelae of instability arthropathy and stabilization procedures (25.7% and 18.5%, respectively). The same rates in the cohort of patients having a shoulder replacement for primary arthritis were 11.5% and 11.5% respectively (Table 3), however, the difference was not statistically significant. Moreover, when TSAs and HAs were compared in the group of post instability patients a trend toward higher revision rate was observed in the group of HAs, which is similar to what has been previously reported in patients with primary osteoarthritis [11, 28, 30].

Finally, when comparing anatomic replacements (TSA, HHR and HA) to RSAs in the cohort of patients having a shoulder arthroplasty in the sequelae of instability arthropathy and stabilization procedures, better outcomes and lower complication and reoperation rates were observed for RSAs.

These informations have implications in daily practice: patients receiving shoulder arthroplasty in the sequelae of shoulder instability should be informed of the higher rate complications and reoperations. In addition, in this specific cohort of patients, the lowest complication and reoperation rates and the best outcomes are observed when rTSA is used; conversely the highest reoperation rate was observed after HAs. Recurrent anterior instability is a risk factor for developing late gleno-humeral instability. Chondral and osteochondral lesions have both been demonstrated during arthroscopic procedures after acute dislocations (within 10 days) in more than half of the cases [33]. Along with the patient's history other patient-related factors such as higher age of the patient at the time of the initial dislocation, the delay between the initial dislocation and surgical stabilization, the age of the patient at the time of the surgical stabilization, the frequency of dislocations and the extent of initial damage to the joint surfaces in the humeral head or glenoid play a significant role [27]. A statistically significant association between the time from injury to surgery and the presence and grade of chondral damage with a linear trend between time from injury to surgery and the grade of chondral damage has been demonstrated [6]. In addition, when surgery is performed, any technical error such as encroachment on the articular cartilage by hardware or a laterally placed bone block and excessive anterior soft-tissue tension as for a Putti-Platt procedure or similar type of intervention ("capsulorrhaphy arthropathy") may have a dramatic impact [1, 3, 34]. The rate of patients undergoing shoulder replacement who have suffered shoulder instability is around 9% [12, 25]; similarly in the series by Neer et al. on 240 shoulder arthroplasties, around 7% had had prior instability repairs [24, 25]. One of the possible explanations of these data is the excessive anterior capsular tightening and internal rotation contracture [3, 15], which is the aim of historical open capsular plications and shifts. In addition, it has been clearly shown in laboratory investigations and biomechanical studies that internal rotation contracture alters glenohumeral mechanics leading to cartilage degeneration [14, 19]. The endpoint is the gradual onset of osteoarthritis that is different than primary osteoarthritis. The local anatomy is more distorted than in primary cases. The glenoid involvement is generally more evident than in primary osteoarthritis cases, with anterior erosion if persistent instability occurs and posterior erosion in case of over-tightened anterior capsule. Therefore, in the setting of a TSA after an instability procedure, the presence of anterior capsule and subscapularis retraction (due to previous surgery and scarring) and posterior glenoid erosion should be expected.

Subscapularis and anterior capsule contracture may lead to severe external rotation deficit as reported by Sperling et al. who reported a preoperative external rotation (ER) of 4° [32]. In the series by Green et al. subscapularis lengthening was performed to improve external rotation in 65% of the cases [13]. However although subscapularis lengthening significantly increased shoulder external rotation, it often led to internal rotation weakness and subscapularis insufficiency [5]. To avoid subscapularis weakness or failure the tendon can be sutured to the anatomical neck rather than to its lateral anatomical insertion on the lesser tuberosity as described by Merolla et al. [23]. They also found that subscapularis shortening and anterior soft-tissue were more severe in patients with a longer interval from shoulder stabilization to replacement.

Posterior glenoid wear is the consequence of posterior subluxation of the humeral head. Glenoid bone grafting or eccentric reaming is advocated by some, as reported by Green et al. who performed them in more than 20% of the cases to correct severe posterior glenoid wear and restore more normal glenoid version [13]. When correct glenoid version is restored, satisfactory radiographic results have been reported with no differences in glenoid stability between post instability patients and primary OA patients [5]. However, the prevalence and extent of posterior glenoid erosion is still discussed with potential long-term implications regarding glenoid implant survival. Although one would expect more erosion in post-surgical patients than in patients with untreated instability some authors did not find any difference between the two cohorts [13, 22]. Moreover, Merolla et al. found posterior glenoid wear was less common in post-surgery cases than in primary osteoarthritis cases [23].

The results of arthroplasty in these shoulders were usually described to be inferior to those typically reported for total shoulder arthroplasty for primary osteoarthritis [2, 9, 25]. We believe that the effects of the previous surgery, including the internal rotation contracture and scarring, were the major factors in this regard. Nonetheless, shoulder arthroplasty greatly decreased pain and improved function in these patients [13]. In the present review the average CM, ASES and SST scores at last follow-up were 72.7, 77 and 8.5, respectively.

The present study has some notable limitations. First, although several databases have been accessed with different combinations of appropriate keywords, it is possible that some articles may not have been included in our search. Second, the majority of the available studies are case series with no control group; this could reduce the scientific relevance of the reported data. Third, when considering complications we defined clinical/surgical complications and imaging complications. In some studies, they were reported as the number of cases while in others as percentage. When they were reported as number of cases, the percentage was then calculated from the total number of patients at follow-up rather than from the initial cohort. This may have overestimated the percentage in some studies.

Nonetheless, the present study has some notable findings. First of all, it is evident that TSA in the sequelae of recurrent dislocation or stabilization surgery is a challenging procedure. Patients are younger and typically more active than in primary osteoarthritis. The challenging anatomy consisting of retracted anterior capsule and posterior glenoid wear should be addressed. Failure in balancing the subscapularis results in instability (loose subscapularis) or stiff shoulder and posterior glenoid erosion (tight subscapularis). In any case, the release of the subscapularis should be carefully performed since it may result in muscle damage and IR weakness. Posterior glenoid wear is more evident in the sequelae of prior capsulorraphy procedure than in dislocation arthropathy and should be accounted for. Glenoid asymmetric reaming or posteriorly augmented glenoid components may be an option; however, RSA should be considered in the most severe cases. Furthermore, the pathogenesis of posterior erosion as a direct consequence of a tight capsular repair should be considered. Several studies did not find any difference in glenoid morphology between post-surgery patients and patients with chronic instability treated conservatively or primary OA cases. The outcomes in this peculiar cohort of patients are generally positive with excellent increase in motion, function and pain relief (average CM, ASES and SST scores at last FU were 72.7, 77 and 8.5, respectively). However, the rate of complications and reoperations in the cohort of patients with sequelae of instability arthropathy and stabilization procedures is higher (25.7% and 18.5%, respectively) than the one of primary arthritis cases (11.5% and 11.5%) probably as a consequence of a more difficult operation. Achieving accurate release of the posterior capsule retraction, the appropriate positioning of the glenoid component in case of severe posterior glenoid erosion, removal of the extensive scar tissue in patients with previous surgery (especially open procedures) and removal of the excessive osteophytes especially in younger patients are the most common tricky aspects. Finally, in the cohort of post instability patients the outcomes of RSAs are superior to those of anatomic replacements (HA, HHR and TSA) and the complications are lower.

Conclusion

Shoulder arthroplasty to treat the sequelae of recurrent instability and stabilization procedures is a challenging procedure. According to the present review, complication and revision rates are more common than following shoulder arthroplasty for primary osteoarthritis, although the differences were not statistically significant. However, the accurate surgical technique may enable positive outcomes in terms of function and motion in this cohort of younger, often multi-operated and active patients. TSA is associated with a lower revision rate than HA in the post instability cohort.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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