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Invited Review

Surgical versus conservative management of Type III acromioclavicular dislocation: a systematic review

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Abstract

Introduction: The management of Type III acromioclavicular (AC) dislocations is still controversial. We wished to compare the rate of recurrence and outcome scores of operative versus non-operative treatment of patients with Type III AC dislocations.

Source of data: A systematic review of the literature was performed by applying the PRISMA guidelines according to the PRISMA checklist and algorithm. A search in Medline, PubMed, Cochrane and CINAHL was performed using combinations of the following keywords: 'dislocation', 'Rockwood', 'type three', 'treatment', 'acromioclavicular' and 'joint'.

Areas of agreement: Fourteen studies were included, evaluating 646 shoulders. The rate of recurrence in the surgical group was 14%. No statistical significant differences were found between conservative and surgical approaches in terms of postoperative osteoarthritis and persistence of pain, although persistence of pain seemed to occur less frequently in patients undergoing a surgical treatment.

Areas of controversy: Persistence of pain seemed to occur less frequently in patients undergoing surgery.

Growing points: Persistence of pain seems to occur less frequently in patients treated surgically for a Type III AC dislocation.

Areas timely for developing research: There is insufficient evidence to establish the effects of surgical versus conservative treatment on functional outcome of patients with AC dislocation. High-quality randomized controlled clinical trials are needed to establish whether there is a difference in functional outcome.

Key words: acromioclavicular, treatment, dislocation, primary, shoulder, arthroscopy, systematic review, Level IV

Introduction

Treatment of chronic acromioclavicular (AC) joint dislocation remains a controversial topic.[1,2] Patients at risk of injuring AC articulation are those involved in sports where physical contact or falls are very common.[3,4] A study conducted on athletes of the English professional rugby union[5] showed that 32% of injuries during a match affect the AC joint.

Different classification systems have been proposed for AC injury to aid diagnosis and management. The most popular of these systems is the Rockwood classification,[6] which expanded on the previously proposed three-tiered classification system to include three more types. Even more recently, the ISAKOS (International Society of Arthroscopy, Knee Surgery & Orthopedic Sports Medicine) Upper Extremity Committee provided a modified Rockwood classification, suggesting the addition of Grade IIIA and Grade IIIB injuries.[7]

According to this classification, Type I injuries are characterized by spraining of the AC ligaments, with no further pathology. There is joint tenderness and swelling clinically, however, radiography shows no widening, deformity or separation at the AC joint. Type II injuries involve complete tear and separation of the AC ligaments, as well as coracoclavicular (CC) sprain or partial tear, causing vertical subluxation of the distal clavicle. Type III injuries involve complete tear of both the AC and CC ligaments, with 100% superior displacement of the distal clavicle. Type III injuries have been further sub-classified into Type IIIA (stable) injuries and Type IIIB (unstable) injuries. Type IIIB lesions cause significant weakness and pain during rotator cuff testing, decreased range of motion during abduction and flexion, and scapular dyskinesis.

Type IV injuries are detected if there is posterior subluxation of the clavicle into the trapezius. A Type V injury is diagnosed if there is 100–300% superior displacement of the clavicle. Type VI injury is rare and occurs when there is inferior clavicular displacement below the acromial or coracoid process creating a reversed CC interspace (Fig. 1).[7]

The aim of treating AC dislocation is to achieve a normal range of motion in a pain-free shoulder with normal strength and minimal activity limitation. Treatment of Type III injury is particularly challenging, as minimal evidence exists on treatment strategies.[8,9] Therefore, the aim of this study is to find the best evidence through reviewing the literature to support the effectiveness of either surgical or conservative treatment of Type III AC dislocations.

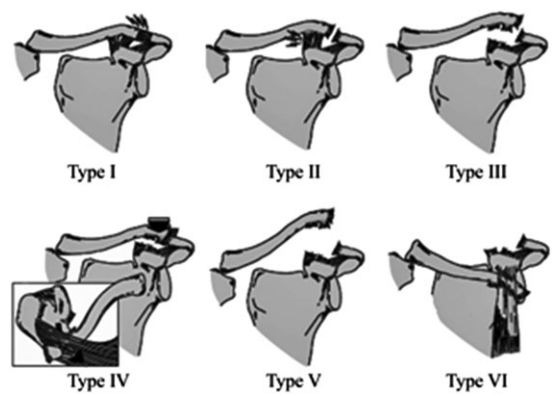

Fig. 1 Rockwood classification.

Materials and methods

We performed a systematic review of the literature according to the PRISMA guidelines with a PRISMA checklist and algorithm.[10] The search algorithm according to the PRISMA guidelines is shown in Figure 2. A comprehensive search of PubMed, Medline, CINAHL, Cochrane, EMBASE and Google Scholar databases using various combinations of the keywords 'dislocation', 'Rockwood', 'type three', 'treatment', 'acromioclavicular' and 'joint', since inception of databases was performed. Three independent reviewers separately conducted the search. All journals were considered, and all relevant studies were analyzed. To qualify for the study, an article had to be published in a peer-reviewed journal.

All articles were initially screened for relevance by title and abstract, excluding articles without an abstract, and obtaining the full-text article if the abstract did not allow the investigators to assess the defined inclusion and exclusion criteria. The three investigators separately reviewed the abstract of each publication and then performed a close reading of all papers and extracted data, to minimize selection bias and errors. A cross-reference research of the selected articles was also performed to obtain other relevant articles for the study. All articles reporting outcomes of surgical or conservative procedures for Type III AC joint dislocation, according to the Rockwood classification, or similar were taken into account.[6]

The following databases were searched: Medline, Google Scholar, EMBASE and Ovid. According to the

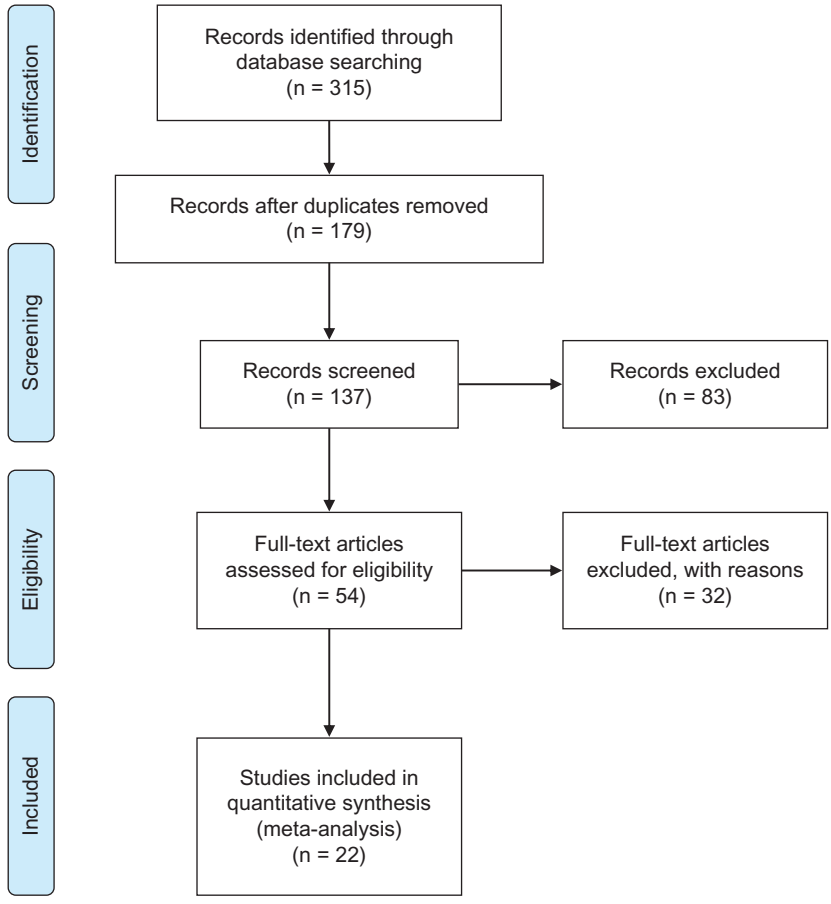

Fig. 2 PRISMA 2009 flow diagram.

Oxford centre of evidence based medicine, Level III–IV articles were found in the literature and included in our study. Given the linguistic capabilities of the authors, articles in English, French, Spanish, German or Italian were included. We included articles published from inception of databases to December 15, 2016 that (i) reported Type III dislocation of AC joint; (ii) presented a sufficient description of the surgical or conservative procedure and follow-up period; and (iii) presented a detailed report of the clinical outcome scores and complications. Missing data pertinent to these parameters warranted exclusion from this systematic review. Literature reviews, case reports, studies on animals, cadavers or *in vitro*, biomechanical reports, technical notes, letters to editors and instructional course materials were excluded. We also excluded articles with no information on surgical intervention, diagnosis, follow-up, imaging, arthroscopic or surgical assessment of AC dislocations, clinical examination, clinical postoperative outcomes and statistical analysis. Finally, to avoid bias, the selected articles, the relative list of references and the articles excluded from the study were reviewed, assessed and discussed by all the authors. If there was disagreement among investigators regarding the inclusion and exclusion criteria, the senior investigator made the final decision. The following data were independently extracted by all the investigators: demographics, previous surgery, imaging assessment, bone defect measurement, diagnosis, surgical management, outcome measurements, return to sport, recurrence of the instability and complications.

Quality assessment

To assess the quality of the evidence in the included studies and to evaluate the strength of recommendation of the intervention that was proposed in the published article we used GRADE[11] (Grading of Recommendations Assessment, Development and Evaluation). GRADE is used to establish the quality of the evidence through four factors: study design, study quality, consistency and directness. The combination of these factors gives a qualitative assessment of the evidence and is graded as high quality, moderate quality, low quality or very low quality.

We performed a statistical analysis with Chi-squared test using Yates correction and Fisher's Exact test. This was used to establish whether the difference in both percentage of recurrence and persistence of pain for surgical versus conservative management was statistically significant. This statistical analysis was used to compare the percentage of recurrence and persistence of pain for the nowadays two most used techniques: hook plate and arthroscopic fixation. Moreover, we performed a statistical analysis with Student's *t*-test to establish whether the difference of the mean postoperative clinical outcome scores was statistical relevant. A P-value < 0.05 was considered significant.

Results

The literature search and cross-referencing resulted in a total of 315 references, of which 244 were rejected because of irrelevant topic abstract and/or failure to fulfill the inclusion criteria (Fig. 1). After reading the 54 full-text articles that remained, another 32 articles were excluded because of insufficient details and uncertain diagnosis or outcome measures. Finally, we included 22 articles, describing patients with Type III AC dislocations.[12–30]

Demographics

A total of 851 shoulders in 851 patients were included, with an average age at surgery of 39.3 years, ranging from 11[16] to 79[16] years (Table 1). The arm involved in the trauma was specified in only six studies[17,22,28,30–32]: the dominant side was involved in 180 (63.6%) of 283 shoulders, while the non-dominant side was involved in 103 (36.4%) shoulders. These data were not reported in the other 16 studies.

Patients were assessed at an average follow-up period of 4.5 years, ranging from 6[26] months to 24.2[12] years. A surgical procedure was performed for 633 (74%) shoulders, while the remaining 218 shoulders (26%) underwent conservative management (Table 2).

Table 1 Details of included studies

Author	Study design (level of evidence)	No. of patients	Mean age (range years)	Side (dominant/ non-dominant)	Time of follow-up
Calvo *et al.*[13]	Retrospective study (III)	43	Surgical group: 39.6 (18–68) years; conservative group: 34.5 (18–63) years		Conservative group 40.5 (12–108) months; surgical group: 122.8 (12–228) months
Cardone *et al.* 2002[32]	Retrospective study (III)	14	Conservative group: 29 (22–41) years; surgical group: 26.7 (21–35) years	Dominant: 9, non-dominant: 5	Conservative group: 29.5 (22–44) months; surgical group: 44.8 (range 31–54) months
Cohen *et al.*[14]	Case series (IV)	13	38 (24–58) years		12 (6–18) months
De Carli *et al.*[23]	Retrospective study (III)	55	28.7 years		3.5 (2–8) years
Di Francesco *et al.* 2012[15]	Cases series (IV)	20	29.1 (18–40) years		1 year
Galpin *et al.*[16]	Retrospective study (III)	37	Conservative group: 36.7 (16–66) years; surgical group: 28.9 (19–59) years		Conservative group: 33.7 (4–120) months; Surgical group: 35.0 (13–90) months
Gstettner *et al.*[17]	Retrospective study (III)	41	Conservative group: 36.2 (21–69) years; surgical group: 37.2 (16–60) years	Dominant: 23, non-dominant: 18	Conservative group 36.8 (14–70) months; surgical group 32.1 (14–56) months
Leidel *et al.*[19]	Retrospective study (III)	70	Overall mean age: 37 years (±11 years). In Group A: 40 years (±11 years), in Group B: 37 years (±12 years) and in Group C: 36 years (±11 years)		Group A: 1–2 years, Group B: 3–5 years and Group C: 6–10 years
Leidel *et al.*[20]	Retrospective study (III)	86	TKW: 37.4 (±11.1) years, PDS: 36.7 (±13.5) years		TKW: 4.4 years (±2.6), PDS 3.2 years (±2.2)
Lizaur *et al.*[12]	Retrospective study (III)	38	57.3 (41–71) years		24.2 (21–26) years
Mulier *et al.*[21]	Retrospective study (III)	42	(17–50) years		6.4 years
Murena *et al.*	Retrospective study (IV)	34	41.8 years		82.7 months
Press *et al.*[31]	Retrospective study (III)	26	Surgical group: 30.7 years (17–49); conservative group: 49.6 years (26–68)	Dominant: 12, non-dominant: 14	Conservative group: 33.4 months; surgical group: 32.3 months
Taft *et al.*[22]	Retrospective study (III)	127	11–79 years	Dominant: 98, non-dominant: 29	Conservative group: 9.5 years (1–29), surgical group: 10.8 years (1–27) and non-treated group: 13 years (6.4–23.5)
Kibler *et al.*[24]	Case series (IV)	9	37 (15–60) years		3 (1.5–5) years
Chaudhary *et al.*[25]	Case series (IV)	6	33.8 (19–48) years		21.1 (12–35) months
Darabos *et al.*[26]	Prospective, randomized, double-blind clinical trial (I)	68	TightRope group: 37.25 (±11.77) years, Bosworth screw group: 41.18 (±14.1) years		6 (–) months

Continued

Table 1 *Continued*

Author	Study design (level of evidence)	No. of patients	Mean age (range years)	Side (dominant/ non-dominant)	Time of follow-up
Ye *et al.*[27]	Prospective, randomized, double-blind clinical trial (I)	46	Group A: 33.4 (±3.3) years; Group B 34.3 (±3.3) years		12 (–) months
Hegazy *et al.*[28]	Retrospective study (III)	20	39 (21–60) years	16/14	27.8 (32–24) months
Joukainen *et al.*[29]	Prospective, randomized, double-blind clinical trial (I)	11	Conservative group 54 ± 8.8 years; surgical group 53 ± 7.8 years		Surgical group: 18.7 ± 0.73 years; conservative group 19.1 ± 0.47 years
Kumar *et al.*[30]	Prospective study (II)	45	34.24 (21–55) years	22/23	23.5 (20–26) months
Total no. of patients		851	Average age: 39.3 years		Average follow-up time: 5.8 years
No. of studies			Total side recorded	Dominant: 180	
Level (I) study		3		Non-dominant: 103	
Level (II) study		1			
Level (III) study		13			
Level (IV) study		5			
Total		22			

TKW, K-wires; PDS, polydioxansulfate sling.

Table 2 Type of treatment and outcome clinical score

Author	Type of treatment	Outcomes score							
		Imatani score	UCLA score	DASH score	Constant score	ASES score	SPADI score	XSMFA-D score	Other score
Calvo *et al.*[13]	Modified Phemister procedure: 32 patients; conservative group: 11 patients	Surgical mean score 93.7 ± 9.9: excellent 21, good 10, fair 0, poor 1. Conservative mean score 94.1 ± 12: excellent 9, good 0, fair 2, poor 0							
Cardone *et al.*[32]	Conservative group: 8 patients; absorbable suture: 6 patients								Subjective shoulder score: conservative group: 72.5 (20–100), surgical group: 87.3 (75–100)
Cohen *et al.*[14]	Arthroscopic stabilization with a synthetic ligament placed between the clavicle and the coracoid				91 (60–100)				
De Carli *et al.*[23]	Group A: conservative treatment 25, Group B: surgical treatment with TightRope™ system30				Group A: 98 ± 3.2, Group B: 98.2 ± 2.8	Group A: 98.5 ± 1.6, Group B: 100			ACJI scores: Group A: 72.4 ± 1.8, Group B: 87.9 ± 2.2
Di Francesco *et al.*[15]	A hook low-profile plate (AC Dreithaler1) is used to reduce and stabilize the AC dislocation				After surgery: excellent (12), good (5), fair (3)				

Continued

Table 2 *Continued*

Author	Type of treatment	Outcomes score							
		Imatani score	UCLA score	DASH score	Constant score	ASES score	SPADI score	XSMFA-D score	Other score
Galpin *et al.*[16]	Bosworth technique: 16 patients; immobilization: 21 patients								Strength index: conservative group (nil 16, mild 1, moderate 1, severe 1); surgical group (nil 12, mild 1, moderate 1, severe 0)
Gstettner *et al.*[17]	Surgery (hook plate): 24 patients, conservative treatment: 17 patients				Surgical group; 90.4 ± 12.9 for injured shoulder and 96.8 ± 4.7 for opposite side. Conservative group; 80.7 ± 17.4 for injured shoulder and 94.6 ± 6.6 for opposite side				SST score: in the surgical group the mean score is 11.3 ± 1.3 in the surgically treated group; OSS score: the mean score is 16.0 ± 4.8. In conservative group: the mean score is 9.9 ± 2.6; OSS mean score is 18.7 ± 6.3
Leidel *et al.*[19]	K-wire transfixation removed after 6 weeks: 70 patients				88 (±13) points in Group A (1–2 years after surgical procedure), 89 (±10) points in Group B (3–5 years after surgical procedure) and 86 (±7) points in Group C (6–10 years after surgical procedure)	Group A: 27 (±6) points, Group B: 29 (±2) points and group C: 29 (±2) points	Group A: 5 (±15) points, in Group B: 2 (±6) points and in Group C: 1 (±3) points	Group A: 13 (±2) points, Group B: 12 (±1) points and Group C: 12 (±1) points	
Leidel *et al.*[20]	Surgery: TKW (70 patients), absorbable PDS (16 patients)				TKW: mean score 87.8 (±10.3), PDS 73 (±17.7)	TKW: mean score 28.5 (±3.4); PDS: mean score 25.4 (±5.0)	TKW: mean score 2.5 (±8.7), PDS: mean score 9.4 (±13.3)	TKW: mean score12.5 (±1.5), PDS: mean score 14.0 (±3.1)	

Lizaur *et al.*[12]	All patients are treated by suture of the deltoid and trapezius over the clavicle with no repair of the CC ligaments, using only temporary fixation with two wires	Postoperative injured shoulder: mean score 91.9 (64–100), uninjured shoulder: mean score 93.1 (72–100)	After surgery: 30.8 (12–35) for the injured and 32.3 (1–35) for the uninjured shoulder	After surgery: mean score 89.1 (36–100)		After surgery: VAS: mean score 8.1 (3–10); SST score: mean score 11.5 (7–12)
Mulier *et al.*[21]	Conservative treatment	After treatment: excellent 38, fair/poor 4				
Murena *et al.*[33]	Open CC screw fixation and, if possible, CC ligament suture: 23; arthroscopic CC screw Fixation: 6, arthroscopic CC fixation by means of double flip button: 5				95.7 ± 5.3	SST score: 11.5 ± 0.8
Press *et al.*[31]	Weaver–Dunn procedure: 16 patients; immobilization: 10 patients					Subjective questionnaire (total score): non-operative group: 15.4 points, operative group 17 points
Taft *et al.*[22]	Bosworth screw or 1–3 Steinmann pin fixation: 52 patients; Sling, Kenny–Howard splint, taping or cast: 63 patients; untreated group: 12 patients					Total ratings of follow-up on a subjective, objective, and roentgenographic basis: non-operative group 8.4 points; operated group 9.4 points; untreated group: 8.2 points

Continued

Table 2 *Continued*

Author	Type of treatment	Outcomes score							
		Imatani score	UCLA score	DASH score	Constant score	ASES score	SPADI score	XSMFA-D score	Other score
Kibler *et al.*[24]	MADOCK AC joint reconstruction procedure			7.5 (0–37)					
Chaudhary *et al.*[25]	arthroscopic TightRope				89.6 (84–91)				
Darabos *et al.*[26]	TightRope group: 34; Bosworth screw group: 34			TightRope group: 6.46; Bosworth screw group: 9.9	TightRope group: 92.22; Bosworth screw group: 87.42				*Oxford score* [TightRope group: 44.59; Bosworth screw group: 43.17]
Ye *et al.*[27]	*Group A*: hook plate; *Group B* autogenous semitendinosus graft and endobutton technique				*Group A*: 80.4 ± 11.5; *Group B*: 90.3 ± 5.4				
Hegazy *et al.*[28]	Weaver–Dunn procedure; anatomic reconstruction of CC ligaments								*Oxford score* [Weaver–Dunn procedure 40.1; anatomic reconstruction of CC ligaments 50.3]; *Nottingham Clavicle Score* [Weaver–Dunn procedure 84.7; anatomic reconstruction of CC ligaments 95.6]; *VAS pain* [Weaver–Dunn procedure 10.7; anatomic reconstruction of CC ligaments 3.7]

Joukainen *et al.*[29]	Conservative group: Kenny- Howard splint (4); surgical group: 2 smooth Kirschner wires (7)	Surgical group 23 ± 6.7; conservative group: 28 ± 2.6	Surgical group 78 ± 21; conservative group: 87 ± 6.5	*Larsen score* [Surgical group 11 ± 1.1; conservative group: 12 ± 0.6]; *Simple Shoulder Test* [Surgical group 9.1 ± 3.8; conservative group: 12 ± 0.5]
Kumar *et al.*[30]	Hook plate	32.3 (31.9–32.6)	91.8 (88.5–93.05)	

ACJI score, Acromioclavicular Joint Instability score; SST, Simple Shoulder Test; OSS, Oxford Shoulder Score; VAS, visual analog scale; TKW, K-Wire; PDS, polydioxansulfate sling.

Recurrence rate and reasons for failure of surgical treatment

The rate of recurrence in the surgical group, defined as postoperative failure of anatomical reduction, was reported in 15 studies,[12,13,15,16,19,21,22,24,25,27–31] describing 427 shoulders (Table 3). In the surgical group, the re-displacement occurred in 62 shoulders, with an overall rate of 14%. The recurrence rate varied according to the different surgical approaches: the use of K-wire transfixation[12,19,29] had a 14.7% of recurrence rate; the Bosworth technique[16,22] was associated to a rate of 37.5%; Phemister procedure[13,15,17] 34.7%; Weaver–Dunn procedure[21,28,31] 38.2%; Hook Plate procedure[27,30] 2.9%; MADOCK AC procedure[24] 0% and arthroscopic procedures[25,27,28] 0%. There is no statistical difference between the recurrence rate of hook plate and arthroscopic procedures (Fisher's exact test P: 1.0000). The reason for failure of surgical treatment was reported in only three studies.[19,20,22] This included K-wire migration in 6 patients (4.3%), migration of fixation device in 17 patients (32.6%) and breakage of fixation device in 6 patients (11.5%).

Outcome measurements

Several outcome measures were reported in the included studies (Table 3). The most frequently reported score was the Constant score, used in 14 (63%) of 22 studies. The mean Constant score was 87.3 for surgical[14,17,19,20,23,25–27,29,30,33] and 88 for conservative[17,23,29] treatment. No statistical difference was detected between the two groups (P = 0.6832). Other less consistently reported scoring systems were the Imitani score and the American Shoulder and Elbow Surgeons (ASES) score, both used in three studies; the Single Assessment Numeric Evaluation (SANE), the Shoulder Pain and Disability Index (SPADI) score, Evaluation of the Extra Short Musculoskeletal Function Assessment questionnaire (XSMFA-D) and The Disabilities of the Arm, Shoulder and Hand (DASH) score function score were used in two studies. University of California at Los Angeles (UCLA) score and Shoulder OUTCOME SCORES (SST) score were also used.

Table 3 Type of treatment and complications

Author	Complications					
	Pain	Reduction of range of shoulder's movement	Re-dislocation or failure after treatment	Osteoarthritis	CC ligaments ossification	Others
Calvo *et al.*[13]			Surgical group: 50% (16/32)	Surgical group: 81.2% (26/32), conservative group: 27.2% (3/11)	Surgical group: 59% (19/32), conservative group: 18% (2/11)	Osteolysis of the lateral clavicle: surgical group: 43.7% (14/32), conservative group: 45.4% (5/11)
Cardone *et al.*[32]	Conservative group: (1) activity-related pain, (1) rest pain; surgical group: (1) activity-related pain		Conservative group: 25% (2/8)			
Cohen *et al.*[14]			15.3% (2/13)			
De Carli *et al.*[23]					Group A 7/25, Group B 21/30	Group B: dislocation of the TightRope 1/30, superficial wound infection 1/30
Di Francesco *et al.*[15]		5% (1/20)	15% (3/20)			
Galpin *et al.*[16]	Conservative group: Nil 15, Mild 5, Moderate 1, Severe 0. Surgical group: Nil 12, Mild 4, Moderate 0, Severe 0		Surgical group: 18.7% (3/16)			
Gstettner *et al.*[17]				Surgical group: 54.1% (13/42)	Surgical group: 33.3% (8/24). Conservative group: 41.2% (7/17)	In conservative group: osteophytes on the caudal side of the lateral clavicle: 100% (17/17)

Leidel *et al.*[20]	(0 = no pain, 10 = max pain): TKW: mean score 0.5 (±0.9); PDS: mean score 1.9 (±1.9)				Pin migration (3)
Leidel *et al.*[19]			11.5% (8/70) secondary dislocation of the AC joint after K-wire removal		4% (3/70) K-wire migration
Lizaur *et al.*[12]	0.079% (3/38)	5.2 % (2/38).	13% (5/38)	28% (11/38)	
Mulier *et al.*[21]			50% (21/42)		
Murena *et al.*[33]					
Press *et al.*[31]			Surgical group: 12.5% (2/16)		Significant decrease of external rotation in faster speed in non-surgical group.
Taft *et al.*[22]			Conservative group: 95.2% (60/63); surgical group: 28.8% (15/52)	Conservative group: 42.8% (27/63); surgical group: 25% (13/52); untreated group: 41.6% (5/12)	Surgical group; fixation device migration: 32.6% (17/52); fixation device breakage: 11.5% (6/52); bone erosion: 19.2% (10/52); hematoma: 9.6% (5/52); infection: 7.6% (4/52); immobilization group: skin necrosis 6.3%
Kibler *et al.*[24]	MADOCK AC joint reconstruction procedure			7.5 (0–37)	
Chaudhary *et al.*[25]		0% (0/6)	0% (0/6)		
Darabos *et al.*[26]	8.8% (6/64)				Screw breakage during removal of the screw 5,8% (4/68)

Continued

Table 3 *Continued*

Author	Complications					
	Pain	Reduction of range of shoulder's movement	Re-dislocation or failure after treatment	Osteoarthritis	CC ligaments ossification	Others
Ye *et al.*[27]	Group A: 43% (10/23); Group B 4.3% (1/23)	Group A: 8.7% (2/23); Group B: 0% (0/23)	Group A: 8.7% (2/23); Group B: 0% (0/23)			
Hegazy *et al.*[28]			Weaver–Dunn procedure 30% (3/10); anatomic reconstruction of CC ligaments 0% (0/10)			
Joukainen *et al.*[29]	Surgical group: 28% (2/7); conservative group: 0% (0/4)		Surgical group 42% (3/7); conservative group 100% (4/4)			
Kumar *et al.*[30]	0% (0/45)		0% (0/45)			

TKW, K-wire; PDS, polydioxansulfate sling.

Complications

Osteoarthritis was reported in four studies[12,13,17,22] with an overall rate of 39.3%. The rate of this complication was similar in the two groups: in the surgical group, the rate was 38.4% (82/164 shoulders), while in the conservative group was 40.5% (30/74 shoulders). The *P*-value calculated with Chi-squared test was 0.9413 using Yates correction and was 0.8953 using Fisher's exact test; therefore, statistical significance was not reached. The persistence of pain was recorded in nine articles.[12,16,20,24,26,27,29,30,32] In the surgical group, the rate was 11% (27 of 240 patients), while in the conservative group was 25% (9 of 36 patients). No statistical significant difference was found both between the surgical and conservative groups (Chi-squared test using *P*: 0.0952, Fisher's exact test *P*: 0.0741) and between hook plate (10/68) and arthroscopic procedures (1/23) (Chi-squared test using *P*: 0.4128, Fisher's exact test *P*: 0.4511). Other complications that were documented include reduced range of motion of the treated shoulder,[12,15,25,27] migration or breakage of fixation device,[19,22,23] CC ligaments ossification and osteolysis of the distal part of the clavicle.[13,17,23] All of these complications occurred in patients treated with pin-fixation techniques.

Quality assessment

To rate the quality of scientific evidences in this systematic review, we used GRADE (Figs 3 and 4).[11] The quality of the evidence for the comparison of surgical versus conservative management and hook plate versus arthroscopic techniques of Type III AC dislocation was found to be 'low', due to the low

Hook Plate compared to Arthroscopic techniques for AC dislocation type III

Patient or population: AC dislocation type III
Setting:
Intervention: Hook Plate
Comparison: Arthroscopic techniques

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk with Arthroscopic techniques	Risk with Hook Plate				
Recurrence	Low		not estimable	3 cases 0 controls 10/68 exposed 0/39 unexposed (3 observational studies)	⨁⨁◯◯ LOW	
	0 per 100	0 per 100 (0 to 0)				

Fig. 3 GRADE summary of findings. Hook Plate versus Arthroscopic technique.

Surgical treatmet compared to Conservative treatment for AC dislocation type III

Patient or population: AC dislocation type III
Setting:
Intervention: Surgical treatmet
Comparison: Conservative treatment

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk with Conservative treatment	Risk with Surgical treatmet				
Pain	Low		not estimable	9 cases 0 controls 27/240 exposed 9/36 unexposed (9 observational studies)	⨁⨁◯◯ LOW	
	0 per 100	0 per 100 (0 to 0)				

Fig. 4 GRADE summary of findings. Surgical versus Conservative treatment.

Level (III) of evidence included in our study, and the scarcity of Levels I and II evidence.

Discussion

The most important finding of this study was that conservative and surgical management showed similar clinical outcomes, including persistence of pain, osteoarthritis prevention and outcome scores. However, persistence of pain was less common in the group of patients managed with surgery (Chi-squared test using *P*: 0.0952, Fisher's exact test *P*: 0.0741). Among the surgical group, arthroscopic and hook plate techniques show lower rate of recurrence and complications compared with 'older' procedures.

The clinical outcome results of the surgical method and the conservative method were comparable. This was demonstrated by the mean Constant score that was 88 for conservative treatment and 87.3 for surgical procedures ($P = 0.6832$). The other scores were not used in enough studies to make an estimate accurate enough to represent the sample size.

The complications were more evident in the surgical group than in the conservative group.[34,35] One of the most important complications in the surgical approach was re-dislocation, with an overall rate of 14%, or failure of surgery. No statistical difference was found between the two most used techniques: Hook Plate and arthroscopic procedures (Fisher's exact test *P*: 1.0000). Re-dislocation was due to erosion of the bone by fixation devices, migration of pins used for fixation, failure of metallic fixation devices and recurrence of deformity. Other surgical complications included a painful or cosmetically displeasing scar, late development of AC arthralgia and the necessity of a second operation to remove fixation devices. No statistical difference was found in either pain or osteoarthritis between the two different approaches. Based on the data, there is growing evidence to suggest that the surgical approach is by no means the gold standard for Type III AC displacement.

On the other hand, if operative management is clearly indicated, it is still plausible that some surgical techniques may show better outcomes than others. In the present systematic review, patients who underwent arthroscopic procedures seem to have a lower rate of residual postoperative pain and postoperative recurrence compared with hook plate technique, even though no statistical differences are found in both cases. These findings probably result from less soft tissues morbidity, and better visualization of the coracoid and intra-articular pathology. However, arthroscopic procedures in this particular pathology can be performed only in highly specialized environment. Moreover, the hook plate often needs to be removed after 6 weeks.[27,30]

The data we reviewed suggested that AC joint pinning was associated with a higher rate of complications than other methods. This was related not only to pin migration and breakage, but also to the development of subsequent arthritis. Furthermore, there were several reports of screw pullout and bone erosion with the Bosworth method of CC fixation. The use of non-metallic fixation seemed to be associated with lower complication rates.

Our systematic review revealed that there were both several advantages and disadvantages associated with conservative treatment. These included the shorter period of rehabilitation, the freedom from hospitalization and satisfactory functional results in general.[36,37] The disadvantages were a moderate rate of persistent pain, instability and limitation of motion. If a reconstructive procedure was needed, it was more difficult to perform surgery after a persistent period of displacement.

With this in mind, surgeons can make an informed evidence-based decision for their patients. Part of the decision making process involves understanding that while the literature may discuss the risks versus the benefits of different methods, it may not definitively point to a particular gold standard management approach. For example, the surgical approach for AC dislocation seemed to be justified only in a few situations: firstly, as a cosmetic procedure in patients with great prominence of the clavicle, since conservative treatment frequently resulted in a persistent deformity; secondly, in patients with particular working environments, especially those requiring 90 degrees of flexion or abduction or both for a long time; and, thirdly, in patients with heavy lifting requirements for work.

ISAKOS Upper Extremity Committee recently suggested to treat Type III AC instability with conservative management, and if persistent pain did not allow patients to return to sport or work for >3–4 weeks a surgical stabilization should be warranted.[7]

There are substantial limitations to this review. Most of the included studies were Level III evidence retrospective study or less, relegating the review to the inherent limitations of this level of evidence. Selection bias was evident in the different patient populations, based on the following continuous and categorical variables: gender, age, arm dominance, smoking status and workers' compensation status. Several studies in this review did not use a validated outcome measure, making comparison among studies difficult.

The stated complication rate, extracted from retrospective data, was likely to be an underestimation of the true complication rate because the authors of the analyzed studies may not have reported minor complications despite their occurrence. In addition, the range of age was very large, from 11 to 79 years, and the activity (level of work or sport) of the different patients was very heterogeneous.

A meta-analysis evaluation was not performed because data and numbers from the available studies were insufficient, the included studies did not use validate outcome measures and data were often incomplete. There is also a potential discrepancy in the prognosis and functional impact of Type III AC dislocations for separate patient populations, such as manual laborers compared with elite athletes; however, these data were not recorded. Some of the Level III studies exhibited selection bias and others did not include some of the complications in the final results.

Ideally, our study should only have compared one type of surgical intervention with conservative management, so as to provide more homogenous comparators. However, as there is not enough data for this study design, we compiled data from various surgical techniques. Unfortunately, there was insubstantial data on each surgical technique to definitively suggest which technique had superiority. In addition, some of the surgical procedures that were performed are seldom used today; making them difficult to recommend to orthopedic surgeons, even with an appropriate sample size.

Further research is required to determine the appropriate management options for acute and severe AC dislocations (Types IV, V and VI). There is also scope for studying the difference in prognosis and responses to different treatment methods in Type IIIA compared with Type IIIB injuries, and hence establish if it is indeed necessary for this subclassification. The use of randomized controlled clinical trials would be beneficial; however, there may be concerns over the potential unethical nature of treating patients with Type III AC dislocations conservatively at random; certainly, management decisions must be correlated clinically. Finally, a meta-analysis evaluation of prospective randomized studies using validated outcome measures is needed and future studies should seek to stratify certain populations that place high demands on the shoulder.

Conclusion

Although persistence of pain seems to occur less frequently in patients having had surgical treatment for a Type III AC dislocation, there is insufficient support in the current literature to establish statistically significant differences in the effects of surgical versus conservative treatment on the functional outcome of patients with AC dislocation. Among the surgical procedures, the nowadays two most used techniques are the hook plate and arthroscopic procedures. The latter seems to have a lower rate of residual postoperative pain and postoperative recurrence but even in this case, more data and therefore more studies are needed to support this finding. Several studies, however, report surgical complications from the breakage and migration of implants especially in case of pin-fixation techniques, used for primary fixation across the AC joint, which sometimes require further intervention. Surgery is also associated with longer hospitalizations and greater recovery times. While these results favor a non-operative approach, possible benefits of surgery cannot be ruled out especially for patients who have a high functional demand, such as laborers

and athletes. Future trials should be developed to assess functional outcomes, using standard and validated measures, including patient assessed functional outcomes, and resource implications.

Conflict of interest statement

The authors have no potential conflicts of interest.

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