

Grade III Acromioclavicular Separations Treated With Suspensory Fixation Techniques: A Systematic Review of Level I Through IV Studies



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Purpose: To perform a systematic review comparing clinical outcomes, radiographic outcomes, and complication rates after acute (surgery ≤ 6 weeks from injury) versus chronic (surgery > 6 weeks from injury) acromioclavicular joint reconstructions for grade III injuries using modern suspensory fixation techniques. **Methods:** We performed a systematic review of the literature examining acute versus chronic surgical treatment of Rockwood grade III acromioclavicular joint separations using the Cochrane registry, MEDLINE database, and Embase database over the past 10 years according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines. The inclusion criteria included techniques using suspensory fixation, a minimum study size of 3 patients, a minimum follow-up period of 6 months, human studies, and English-language studies. The methodology of each study was evaluated using the Methodological Index for Non-randomized Studies (MINORS) tool for nonrandomized studies and the revised Cochrane risk-of-bias (RoB 2) tool for randomized controlled trials. **Results:** The systematic review search yielded 20 studies with a total of 253 patients. There were 2 prospective randomized controlled trials, but most of the included studies were retrospective. On comparison of acute surgery (≤ 6 weeks) and chronic surgery (> 6 weeks), individual studies reported a range of Constant scores of 84.4 to 98.2 and 80.8 to 94.1, respectively. The ranges of radiographic coracoclavicular distances reported at final follow-up also favored acute reconstructions, which showed improved reduction (9.2-15.7 mm and 11.7-18.6 mm, respectively). The reported complication rates ranged from 7% to 67% for acute reconstructions and from 0% to 30% for chronic reconstructions. **Conclusions:** The ranges in the Constant score may favor acute reconstructions, but because of the heterogeneity in the surgical techniques in the literature, no definitive recommendations can be made regarding optimal timing. **Level of Evidence:** Level IV, systematic review of Level I through IV studies.

Acromioclavicular joint (ACJ) injuries are very common shoulder injuries, especially in athletes, representing 12% of all shoulder injuries.¹ ACJ dislocations are most commonly classified according to the Rockwood classification.² Although there is consensus on conservative therapy in grade I and II injuries and operative treatment in grade IV to VI injuries, there is

an ongoing debate regarding the optimal treatment strategy for grade III injuries, which are characterized by superior displacement of the distal clavicle by 1 clavicular diameter (100%) on an anteroposterior radiograph.

Over a decade ago, Spencer³ systematically reviewed grade III acromioclavicular (AC) separations focusing on

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Table 1. Quality of Randomized Controlled Trials Using Cochrane Risk of Bias (RoB 2) Tool

Cochrane Risk	Cai et al. ³³	Ye et al. ²³
Bias arising from randomization process	Low risk	Low risk
Bias owing to deviations from intended interventions	Low risk	Low risk
Bias owing to missing outcome data	Low risk	Low risk
Bias in measurement of outcome	Some concerns	Low risk
Bias in selection of reported result	Low risk	Low risk
Overall bias	Some concerns	Low risk

operative and conservative approaches. He concluded that “nonoperative treatment is superior to traditional operative treatment in the management of grade III AC separations.” Since the time of that publication, operative treatment of AC separations has dramatically changed. At that time, anatomic coracoclavicular (CC) reconstruction with cortical buttons and sutures and/or grafts was in its infancy as evidenced by only a few included studies using suspensory fixation techniques in

that publication.³ Several additional recently published systematic reviews have also attempted to summarize the literature on surgical and conservative treatment of grade III injuries. These reviews found advantages and disadvantages of each approach but were unable to conclude that either was superior to the other.⁴⁻⁷ Unfortunately, these studies included a variety of older reconstructive techniques, many of which are not commonly used today, and did not address time to surgical treatment and its effect on results.

The purpose of this study was to perform a systematic review comparing clinical outcomes, radiographic outcomes, and complication rates after acute (surgery ≤ 6 weeks from injury) versus chronic (surgery > 6 weeks from injury) ACJ reconstructions for grade III injuries using modern suspensory fixation techniques. We hypothesized that acute reconstructions would have improved patient-reported outcome measures (PROMs) and smaller final CC distances with a similar complication rate when compared with chronic reconstructions.

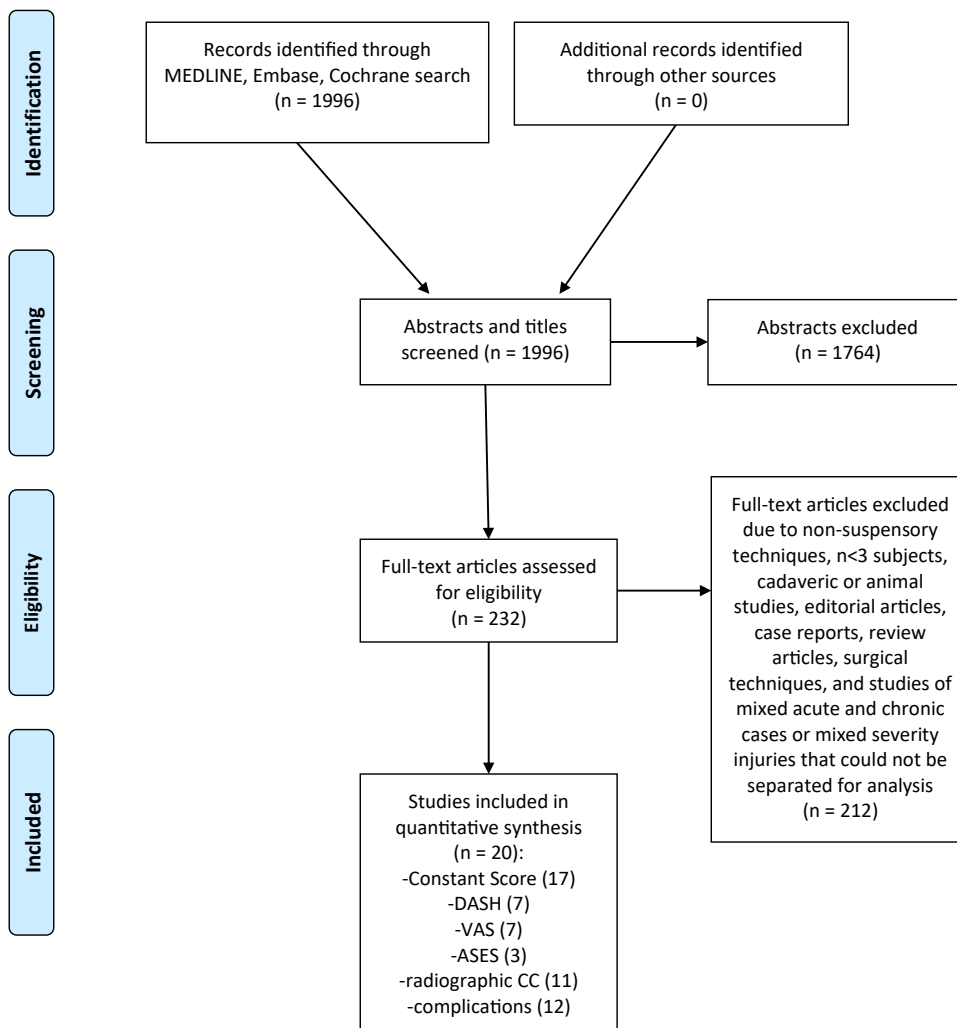


Fig 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) flow diagram of included studies. (ASES, American Shoulder and Elbow Surgeons; CC, coracoclavicular; DASH, Disabilities of the Arm, Shoulder and Hand; VAS, visual analog scale.)

Table 2. Quality Scoring of Included Studies Based on MINORS Criteria

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	MINORS Score
Acar et al. ³⁶	2	0	0	2	0	1	0	0					5 of 16
Beris et al. ¹⁸	2	0	0	2	0	1	0	0					5 of 16
Bhingraj et al. ²⁹	2	0	0	2	0	1	0	0					5 of 16
Chaudhary et al. ³⁷	2	0	0	1	0	1	0	0					4 of 16
Chouhan et al. ³⁸	0	0	1	2	0	1	0	0					4 of 16
Darabos et al. ³⁴	2	0	2	2	2	1	1	0	1	2	2	0	15 of 24
De Carli et al. ⁴⁰	2	0	0	2	0	2	1	0	1	1	1	0	10 of 24
Gangary and Meena ⁴⁴	2	1	2	1	0	1	1	0					8 of 16
Gogna et al. ³²	0	1	0	1	0	1	2	0					5 of 16
Gupta et al. ³⁵	0	1	1	1	0	1	0	0					4 of 16
Hegazy et al. ²⁷	2	0	1	1	0	2	0	0	1	1	2	0	10 of 24
Kibler et al. ²⁸	2	0	1	1	0	1	0	0					5 of 16
Kocaoglu et al. ³⁹	2	1	0	2	0	2	0	0	1	0	0	0	8 of 24
Muench et al. ⁴¹	2	0	0	2	0	2	0	0					6 of 16
Spoliti et al. ²⁰	2	0	0	1	0	1	1	0					5 of 16
Vascellari et al. ¹²	2	0	0	2	0	1	0	0	1	1	0	0	7 of 24
Wright et al. ²²	2	2	0	1	0	1	2	0					8 of 16
Yoo et al. ²⁴	2	2	0	2	0	2	2	0					10 of 16
Zhang et al. ²⁵	2	1	0	2	0	2	1	0					8 of 16

MINORS, Methodological Index for Non-randomized Studies.

Methods

Article Identification and Selection

This review was performed according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines.⁸ A systematic review of the literature regarding acute versus chronic surgical treatment of Rockwood grade III ACJ separations was performed using 3 separate manuscript repositories—Cochrane registry, MEDLINE database, and Embase database—over the prior 10 years, from January 1, 2010, to January 1, 2020, to capture modern reconstructive techniques. The queries were performed on January 24, 2020. The formal search queries for each database included the terms “acromioclavicular,” “coracoclavicular,” and “surgery” or “reconstruction.”

The inclusion criteria encompassed techniques using anatomic CC reconstruction with cortical buttons and sutures or tissue grafts, a minimum study size of 3 patients; a minimum follow-up period of 6 months; human studies; and studies published in or translated into the English language. We excluded any studies reporting on reconstruction techniques using plates, screws, pins, or coracoacromial ligament transfers (i.e., Weaver-Dunn modification)⁹; cadaveric studies; animal studies; editorial articles; case reports; review articles; surgical techniques; and studies of mixed acute and chronic cases or mixed-severity injuries that could not be separated for analysis. Acute reconstructions were defined as those performed within 6 weeks of injury, whereas chronic reconstructions were those completed after 6 weeks. The intermediate time point of 6 weeks

was chosen because some authors have described 3 weeks as the “acute” window in which the CC ligaments have the ability to heal^{10,11} and some chose 4 weeks,¹² whereas others have described chronic injuries as those treated several months after the injuries.¹³

Two independent orthopaedic surgeon reviewers (J.J.R. and P-C.N.) performed a review of the abstracts from all queried articles. A parallel full-text review was performed by the same authors. A third, medical student reviewer (B.P.E.) reconciled all disputes. All references and systematic reviews encountered were reviewed to ensure complete article catchment.

Data Collection and Processing

Each included article was assigned a level-of-evidence designation according to Wright et al.¹⁴ Data were directly extracted from the article text, tables, and appendices. Collected data included publication details, patient demographic characteristics, follow-up duration, minimum follow-up, surgical techniques, clinical measures and PROMs, radiographic CC displacement (CC distance), and complications. If mixed populations of Rockwood grades were reported, the grade III injuries were separated out and new descriptive statistics were calculated. Shoulder and upper-extremity PROMs that were collected included the Constant score (CS); American Shoulder and Elbow Surgeons score; Disabilities of the Arm, Shoulder and Hand score; Oxford Shoulder Score; and visual analog scale score. The rate of return to work, if provided, was also collected.

Table 3. Studies Comparing Clinical and Radiographic Outcomes of Acute (≤ 6 Weeks) Versus Chronic (>6 Weeks) Acromioclavicular Joint Separations

Authors	Year	Journal	LOE	Technique	Cases, n		Mean Age, yr	Minimum FU, mo	Outcomes		
					Acute	Chronic			Measure	Acute	Chronic
Acar et al. ³⁶	2015	<i>Acta Orthopaedica et Traumatologica Turcica</i>	IV	Percutaneous, 2 suspensory buttons	13	—	43.4	9	Mean CS	84.4	—
									Mean DASH score	0.4	—
									Mean VAS score	0.6	—
									Mean postoperative CCD, mm	9.23	—
									Complication rate, %	NA	—
Beris et al. ¹⁸	2013	<i>Injury</i>	IV	Open, 2 suspensory buttons	8	—	27.5	12	Mean CS	94.1	—
									Mean DASH score	0.375	—
									Mean VAS score	0.25	—
									Mean postoperative CCD, mm	10.5	—
									Complication rate, %	12.5	—
Bhingraj et al. ²⁹	2019	<i>Journal of Arthroscopy and Joint Surgery</i>	IV	Arthroscopy assisted, 2 suspensory buttons	4	—	42.5	12	Mean CS	90.25	—
									Return to work, %	100	—
									Mean postoperative CCD, mm	11.25	—
									Mean VAS score	0.5	—
									Complication rate, %	0	—
Cai et al. ³³	2018	<i>Journal of Investigative Surgery</i>	I	Open, 2 suspensory buttons	30	—	42.8	12	Mean CS	92	—
									Mean VAS score	0.97	—
									Mean postoperative CCD, mm	12.3	—
									Complication rate, %	10	—
									Mean CS	89.7	—
Chaudhary et al. ³⁷	2015	<i>Journal of Orthopaedic Surgery</i>	IV	Arthroscopy assisted, 2 suspensory buttons	6	—	33.8	12	Return to work, %	100	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	NA	—
									Mean CS	—	91
									Mean ASES score	—	93
Chouhan et al. ³⁸	2013	<i>Chinese Journal of Traumatology</i>	IV	Open, LARS	—	8	33	8	Mean VAS score	—	2
									Mean postoperative CCD, mm	—	NA
									Complication rate, %	—	12.5
									Mean CS	92.22	—
									Mean DASH score	6.46	—
Darabos et al. ³⁴	2015	<i>Injury</i>	I	Open, 2 suspensory buttons	34	—	37.25	6	Mean OSS	44.6	—
									Mean postoperative CCD, mm	15.74	—
									Complication rate, %	5.88	—
									Mean CS	98.2	—
									Mean ASES score	100	—
De Carli et al. ⁴⁰	2015	<i>Journal of Orthopaedic Surgery and Research</i>	III	Open, 2 suspensory buttons	30	—	28.7	24	Mean postoperative CCD, mm	NA	—
									Complication rate, %	6.7	—
									Mean CS	NA	—
									Mean postoperative CCD, mm	14.8	—
									Complication rate, %	66.7	—
Gangary and Meena ⁴⁴	2016	<i>Journal of Arthroscopy and Joint Surgery</i>	IV	Arthroscopy assisted, 2 suspensory buttons	6	—	35	12	Mean CS	NA	—
									Mean postoperative CCD, mm	14.8	—
									Complication rate, %	66.7	—
									Mean CS	NA	—
									Mean DASH score	2.63	—
Gogna et al. ³²	2015	<i>Musculoskeletal Surgery</i>	IV	Open, autograft (palmaris longus)	5	—	27.6	18	Mean VAS score	0	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	0	—
									Mean CS	NA	—
									Mean DASH score	2.63	—

(continued)

Table 3. Continued

Authors	Year	Journal	LOE	Technique	Cases, n		Mean Age, yr	Minimum FU, mo	Outcomes		
					Acute	Chronic			Measure		Acute
Gupta et al. ³⁵	2016	<i>Journal of Arthroscopy and Joint Surgery</i>	IV	Arthroscopy assisted, 2 suspensory buttons	3	—	28.7	12	Mean CS	93	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	0	—
Hegazy et al. ²⁷	2016	<i>The Open Orthopaedics Journal</i>	III	Open, autograft (semitendinosus)	—	10	37.9	24	Mean CS	NA	—
									Mean OSS	50	—
									Mean VAS score	4	—
									Mean postoperative CCD, mm	11.7	—
									Complication rate, %	30	—
									Mean CS	NA	NA
									Mean postoperative CCD, mm	NA	NA
									Complication rate, %	NA	NA
Kibler et al. ²⁸	2017	<i>Arthroscopy</i>	IV	Open, allograft (semitendinosus) and PDS	—	12	38.9	18	Mean CS	—	NA
									Mean DASH score	—	12.75
									Mean postoperative CCD, mm	—	12.2
									Complication rate, %	—	0
Kocaoglu et al. ³⁹	2017	<i>Journal of Shoulder and Elbow Surgery</i>	III	Open, autograft (palmaris longus) and 2 buttons	—	12	41.5	29	Mean CS	—	93.1
									Mean ASES score	—	94.5
									Mean postoperative CCD, mm	—	13.9
									Complication rate, %	—	0
									Mean ASES score	98.35	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	0	—
Muench et al. ⁴¹	2019	<i>The Orthopaedic Journal of Sports Medicine</i>	IV	Open, allograft (semitendinosus or peroneus longus)	—	20	43.4	24	Mean CS	85.3	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	NA	—
									Mean DASH score	25.2	26.9
									Mean OSS	33.5	36.5
									Mean postoperative CCD, mm	NA	NA
									Complication rate, %	100	50
Spoliti et al. ²⁰	2014	<i>Muscles, Ligaments and Tendons Journal</i>	IV	Open, 2 suspensory buttons	6	—	31.6	12	Mean CS	93.3	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	NA	—
Vascellari et al. ¹²	2015	<i>Joints</i>	III	Arthroscopy assisted, LARS/GraftRope (Arthrex)/TightRope (Arthrex) and allograft (not specified)	12	6	Acute: 44.9 Chronic: 52.7	Acute: 15 Chronic: 12	Mean CS	96.5	92.2
									Mean DASH score	9.9	10.9
									Mean postoperative CCD, mm	12.8	18.6
									Complication rate, %	NA	NA
									Mean VAS score	0	—
									Mean postoperative CCD, mm	NA	—
									Complication rate, %	NA	—
Wright et al. ²²	2015	<i>Journal of Orthopaedic Surgery</i>	IV	Open, 1 suspensory button	—	12	40	13	Mean CS	—	88.9
									Mean OSS	—	44
									Mean postoperative CCD, mm	—	NA
									Complication rate, %	—	NA

(continued)

Table 3. Continued

Authors	Year	Journal	LOE	Technique	Cases, n		Mean Age, yr	Minimum FU, mo	Outcomes		
					Acute	Chronic			Measure	Acute	Chronic
Ye et al. ²³	2016	<i>Therapeutics and Clinical Risk Management</i>	I	Open, 2 suspensory buttons	23	—	34.3	6	Mean CS	90.3	—
Yoo et al. ²⁴	2010	<i>The American Journal of Sports Medicine</i>	IV	Open, 2 suspensory buttons and autograft (semitendinosus)	—	5	33	21	Mean postoperative CCD, mm Complication rate, % Mean CS	NA NA —	— — 80.8
Zhang et al. ²⁵	2017	<i>Journal of Orthopaedic Surgery</i>	IV	Arthroscopy assisted, 2 suspensory buttons	8	—	25.6	24	Mean postoperative CCD, mm Complication rate, %	91.9 NA NA	— — —

ASES, American Shoulder and Elbow Surgeons; CCD, coracoclavicular distance; CS, Constant score; DASH, Disabilities of the Arm, Shoulder and Hand; FU, follow-up; LARS, ligament advanced reinforcement system; LOE, level of evidence; PDS, polydioxanone; NA, not applicable; VAS, visual analog scale.

Literature Quality Evaluation

An orthopaedic surgeon (J.W.A.) and medical student reviewer (B.P.E.) used the Methodological Index for Non-randomized Studies (MINORS) tool to assess the methodologic quality and rigor of each included non-randomized study. This tool contains 12 items with the last 4 criteria specific for comparative studies only. If the parameter was reported appropriately, then a score of 2 was given for the individual item; if it was reported but was inadequate, then a score of 1 was given; and if the item was not reported, then a score of 0 was given. A maximum of score of 24 points is possible for comparative studies, whereas the maximum score is 16 for noncomparative studies.¹⁵

The revised Cochrane risk-of-bias (RoB 2) tool was used to assess the quality of randomized controlled trials (RCTs) (Table 1).¹⁶ The RoB 2 tool consists of 5 domains: (1) bias arising from the randomization process, (2) bias owing to deviations from intended interventions, (3) bias owing to missing outcome data, (4) bias in measurement of the outcome, and (5) bias in selection of the reported result. These domains were individually assessed for low risk, high risk, or some concerns regarding the risk of bias by responding to signaling questions. Response options included the following: yes, probably yes, probably no, no, and no information. Responses were translated into an overall judgment of bias for each domain using a pre-determined algorithm. The overall risk-of-bias judgment was determined based on the judgments from each domain.

Results

The systematic search from 3 databases yielded 20 studies that met the specified inclusion criteria after exclusion of duplications among the databases. No additional studies were included from the analyses of both included studies' references and prior systematic reviews on the topic. The complete PRISMA flow diagram is presented in Figure 1. The results of the methodologic assessments are presented in Tables 1 and 2.

Study and Demographic Characteristics

Two prospective RCTs, 1 prospective nonrandomized study, and 17 retrospective case series and comparative studies were included in this systematic review. Thirteen studies reported only on acute AC reconstructions, 6 studies reported only on chronic AC reconstructions, and 1 study reported on a mixed population of acute and chronic reconstructions. Neither weighted means nor statistical significance was calculated amid the heterogeneity in the included studies as recommended by a previous publication in *Arthroscopy* by Harris et al.¹⁷ and in accordance with the journal's guidelines for systematic reviews.

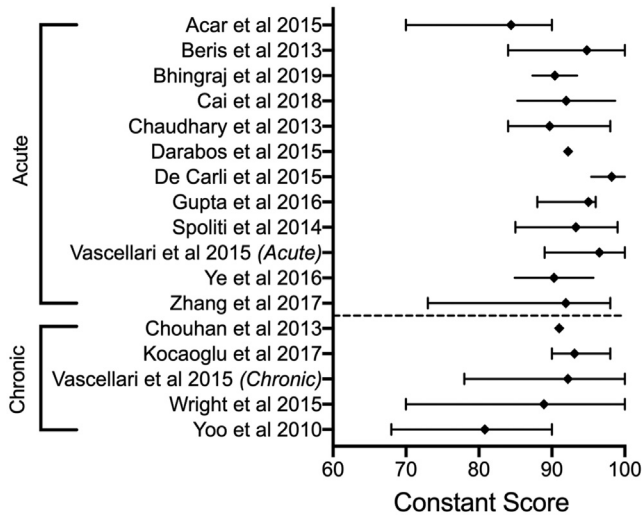


Fig 2. Forest plot representing reported Constant scores of included studies. Open error bars represent standard deviations; closed error bars represent ranges.

The 20 studies included reported on a total of 253 patients. Of these patients, 188 underwent acute reconstructions and 65 underwent chronic reconstructions (range, 3-34 patients per study). The mean patient age was 34.5 years (range, 25-45 years) in the acute cohort and 40.5 years (range, 33-43 years) in the chronic cohort. The mean follow-up duration was 22.3 months (range, 6-42.5 months) in the acute cohort and 37.6 months (range, 27.7-46.7 months) in the chronic cohort. The mean rate of follow-up for both cohorts was 95.5% (range, 77.4%-100%). As for surgical technique, 6 of the 20 studies (30%) used arthroscopic-assisted techniques. Of the 12 studies in which acute reconstructions were performed, 3 (25%) used a tendon graft, whereas 5 of the 7 studies reporting on chronic reconstructions (71%) used an allograft or autograft tendon. Study characteristics, patient demographic characteristics, and surgical details are reported in Table 3.

Clinical and Patient-Reported Outcomes

Postoperative clinical measures and PROMs for acute and chronic AC reconstruction were assessed in all 20 studies (Table 3).^{12,18-39} Six outcome measures were reported in these 20 studies. The CS was the most common outcome measure reported (17 studies),^{12,18-23,25,26,29,31,33-42} followed by the Disabilities of the Arm, Shoulder and Hand score (7 studies),^{12,18,28,31,32,34,36} visual analog scale score (7 studies),^{18,27,29,32,33,36,38} American Shoulder and Elbow Surgeons score (3 studies),³⁸⁻⁴⁰ Oxford Shoulder Score (3 studies),^{22,32,34} and return to work (2 studies).^{29,37}

The range of CSs in patients undergoing acute reconstructions was 84.4 to 98.2, whereas patients undergoing chronic reconstructions had a range of 80.8 to

94.1. A forest plot of the reported CSs is presented in Figure 2.

Radiographic Analysis

Postoperative radiographic analysis of the CC distance on calibrated anteroposterior radiographs was performed in 11 studies.^{12,18,27-29,33,34,36,39,43,44} The range of reported CC distances in patients undergoing acute reconstruction was 9.2 to 15.7 mm, whereas that in patients undergoing chronic reconstruction was 11.7 to 18.6 mm. These results are summarized in Table 3. A forest plot of the reported CC distances is presented in Figure 3.

Complications

Complications were reported in 12 studies.^{18,19,21,27-29,31-35,38-40,43-46} The complications reported were all minor, with no major neurovascular complications. Reported complications included infection, wound healing problems, construct failure, loss of reduction, and persistent pain. The range of complication rates in patients undergoing acute reconstruction was 7% to 67%, whereas that in patients undergoing chronic reconstruction was 0% to 30%. These results are summarized in Table 3. A forest plot of the reported complications is presented in Figure 4.

Discussion

The most important findings of this study are that anatomic CC reconstruction with cortical buttons and sutures and/or grafts for grade III AC separations results in high clinical and patient-reported metrics at final follow-up. Grade III AC separations treated within 6 weeks of injury had a range of CSs of 84.4 to 98.2, whereas those treated after 6 weeks had a range of 80.8 to 94.1. Radiologically, those treated acutely had a

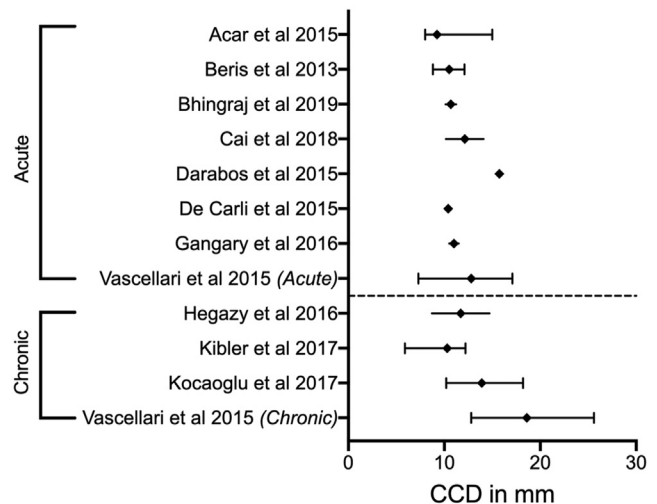


Fig 3. Forest plot representing coracoclavicular distances (CCD) of included studies. Open error bars represent standard deviations; closed error bars represent ranges.

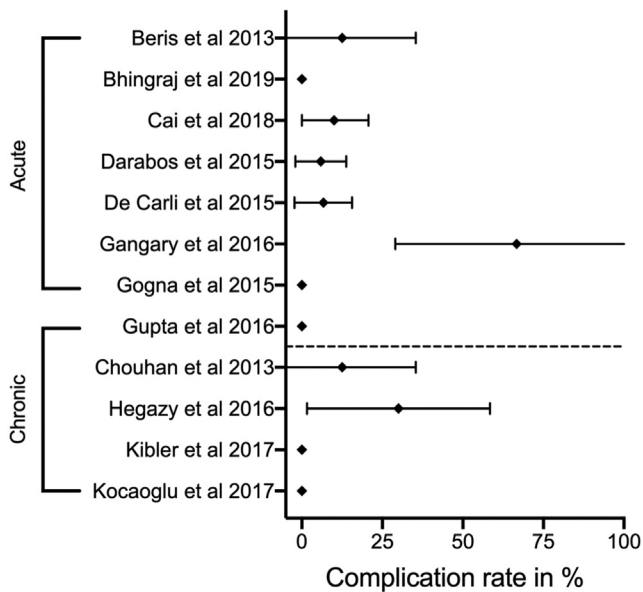


Fig 4. Forest plot representing reported complication rates of included studies. Error bars represent 95% confidence intervals.

range of CC distances of 9.2 to 15.7 mm whereas those treated in the chronic setting had a range of 11.7 to 18.6 mm. Finally, the reported complication rates for acutely treated AC separations ranged from 6% to 67%, whereas those for chronically treated cases ranged from 0% to 30%. Although the clinical and radiographic outcomes slightly favored acute reconstructions, the heterogeneity in the methods, as well as the high proportion of Level IV evidence, precludes a determination of superiority.

In the past 15 years, several systematic reviews and comparative studies have focused on grade III AC separations, comparing operative versus nonoperative management.^{3-6,47} Unfortunately, each reported conflicting results and none was able to make a strong recommendation for surgical versus nonsurgical management. Approaching this same clinical question from a different perspective, the goal of this systematic review was to ask the following question: In patients in whom nonoperative management fails and who eventually undergo surgery, are the results the same as those of patients who undergo surgery acutely? The results indicate that the clinical and radiographic parameters may slightly favor patients undergoing acute surgical reconstruction.

In 2013, the International Society of Arthroscopy, Knee Surgery & Orthopaedic Sports Medicine Upper Extremity Committee suggested subdividing grade III AC separations into grades IIIA and IIIB.⁴⁸ In its consensus statement, grade IIIA injuries were considered stable and grade IIIB injuries were considered unstable with radiographic and clinical findings showing additional horizontal instability. Unstable grade IIIB injuries with

existing horizontal instability may be more likely to result in ongoing morbidity and, hence, require early surgical treatment. However, most of the studies included in this article did not differentiate between those 2 subcategories, making comparisons challenging.

Furthermore, the terminology of acute versus chronic ACJ separations remains ill defined.^{49,50} Some authors define acute injuries as those treated at less than 3 weeks and chronic injuries as those treated at more than 6 weeks, leaving a “gray area” of 3 weeks. However, given the popular recommendation to perform an initial course of nonoperative management in grade III ACJ injuries, acute treatment (<3 weeks) is nearly impossible when taking into account that reasonable nonoperative treatment continues for at least 6 weeks. For this reason, some authors define acute ACJ separations as those treated at less than 6 months.⁴¹ In our analysis, 6 weeks or less was arbitrarily chosen as the definition of acute.

It is important to acknowledge that although the included studies used variations of modern techniques of anatomic CC fixation devices for AC separation reconstruction,⁵¹⁻⁵³ the included surgical techniques are still likely not the perfect solution because several significant technical limitations exist, including hardware failure,⁵⁴ fracture due to bone tunnels,⁵⁵⁻⁵⁸ and horizontal AC instability.^{59,60} It is interesting to note that only 2 included studies^{27,45} included some form of ACJ capsule reconstruction as part of their CC reconstruction. Although CC suspensory fixation is likely a part of the ideal solution, the use of arthroscopy to address associated pathology,^{61,62} grafts to enhance biology, avoidance of large bone tunnels, and extension to the ACJ are all likely components of more ideal and successful solutions.

Limitations

This systematic review has several important limitations that must be considered. First, there was extensive heterogeneity in both the techniques used and the clinical and patient-reported outcomes among the studies, in addition to the varied classification of surgical timing as acute and chronic. Although the great majority of the studies used a construct of 2 buttons and a ligament or suture, each reconstruction style was unique with slight nuances. Because there are over 162 described techniques for AC reconstruction,⁶³ determining any cohesive group of surgical treatment is extremely difficult, but care was taken to choose as homogeneous a cohort as possible. Additionally, given that the CS was reported in 17 of 20 included studies and was reported more than twice as frequently as any other clinical measure or PROM, this was chosen as the primary clinical variable by which to report results for acute and chronic reconstructions. Second, the quality of evidence was notably poor. Only 2 of 20 studies were

prospective RCTs. None of the studies were designed or specifically powered to compare acute versus chronic reconstructions. This low quality of evidence precluded a formal meta-analysis. For this reason, no formal *P* values or comparisons were made; only simple descriptive statistics were used for summarizing the results.

Conclusions

The ranges in the CS may favor acute reconstructions, but because of the heterogeneity in the surgical techniques in the literature, no definitive recommendations can be made regarding optimal timing.

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