



Return to Play After Surgical Treatment for Acromioclavicular Joint Dislocation



A Systematic Review

Brian P. Cleary,* Eoghan T. Hurley,*^{†‡} MB BCH, MCh, PhD , Conor J. Kilkenny,* MB BCH, Jake Robinson,* MB BCH, Sami U. Khan,* FRCS (Tr & Orth), Martin S. Davey,* MCh, MRCS , Oke Anakwenze,[‡] MD, MBA, Christopher S. Klifto,[‡] MD, and Hannan Mullett,* FRCS (Tr & Orth)
Investigation performed at the Sports Surgery Clinic, Dublin, Ireland

Background: Acromioclavicular (AC) joint dislocation is a common clinical problem among young and athletic populations. Surgical management is widely used for high-grade dislocations (Rockwood III-VI) and in high-demand athletes at high risk of recurrence.

Purpose: To systematically review the evidence in the literature to ascertain the rate and timing of return to play (RTP) and the availability of specific criteria for safe RTP after surgical treatment for AC joint dislocation.

Study Design: Systematic review; Level of evidence, 4.

Methods: A systematic literature search based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines was conducted in the PubMed database. Clinical studies were eligible for inclusion if they reported on RTP after surgical treatment for AC joint dislocation. Statistical analysis was performed with SPSS.

Results: We found 120 studies including 4327 cases meeting our inclusion criteria. The majority of patients were male (80.2%), with a mean age of 37.2 years (range, 15-85) and a mean follow-up of 34.5 months. Most were recreational athletes (79%), and the most common sport was cycling. The overall rate of RTP was 91.5%, with 85.6% returning to the same level of play. Among collision athletes, the rate of RTP was 97.3%, with 97.2% returning to the same level of play. In overhead athletes, the rate of RTP was 97.1%, with 79.2% returning to the same level of play. The mean time to RTP was 5.7 months (range, 1.5-15). Specific RTP criteria were reported in the majority of the studies (83.3%); time to return to play was the most commonly reported item (83.3%). Type III Rockwood injuries had the highest RTP rate at 98.7% and the earliest RTP at 4.9 months. Among the different surgical techniques, Kirschner wire fixation had the highest rate of RTP at 98.5%, while isolated graft reconstruction had the earliest RTP at 3.6 months.

Conclusion: The overall rate of RTP was reportedly high after surgical treatment for AC joint dislocation, with the majority of patients returning to their preinjury levels of sport. There is a lack of consensus in the literature for what constitutes a safe RTP, with further focus on this topic required in future studies.

Keywords: acromioclavicular dislocation; AC joint; Rockwood; systematic review; return to play

Acromioclavicular (AC) joint dislocations are responsible for almost 50% of all sports-related shoulder injuries.^{1,7,20} This injury is especially common in athletes and highest among adults in the 20- to 30-year age bracket.^{12,17,19} Classification of AC joint dislocation is dependent on the degree of dislocation and follows the 6-grade Rockwood classification.⁸ Types I and II are generally managed nonoperatively while types IV to VI require surgical treatment, with controversy surrounding the treatment of type III dislocations.¹³

In athletes undergoing shoulder surgery, return to play (RTP) at the preinjury level is one of the most important expectations among patients.²² Among those undergoing AC joint stabilization, high rates of return have been reported. In a systematic review, Verstift et al²¹ found a 94% rate of RTP at a mean 4 months postoperatively, with 84% returning to the preinjury level of play. However, previous systematic reviews have not analyzed the rates and timing of RTP after surgical treatment involving all grades of AC joint dislocation. Additionally, no validated criteria for safe RTP after AC joint surgery are available.

Therefore, the purpose of this study is to systematically review the evidence in the literature to ascertain the rate and timing of RTP and the availability of specific criteria for safe RTP after surgical treatment for AC joint dislocation.

Our hypothesis was that surgery would result in high rates of RTP but that criteria for RTP would be scantily reported.

METHODS

Search Strategy and Study Selection

The literature search was performed by 2 authors, who used the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and reviewed the search results.¹⁶ The titles and abstracts identified in the search were screened, and potentially eligible studies received a full-text review. The following search terms were used in the PubMed database in April 2022 as the search algorithm: ((acromioclavicular joint) AND (oper* OR surg* OR arthrosc*)). No time limit was given to publication date.

Eligibility Criteria

The inclusion criteria were the following: (1) clinical study involving surgery for AC joint dislocation, (2) report on RTP or RTP criteria, (3) published in a peer-reviewed journal, and (4) published in English. The exclusion criteria were review studies, cadaveric studies, biomechanical studies, and abstract only.

Data Extraction and Analysis

The relevant information regarding the study characteristics—including the study design, level of evidence, methodological quality of evidence, population, clinical outcome measures, and follow-up time points—was collected by 1 author (B.C.) using a predetermined data sheet. The level of evidence was evaluated per the guidelines by the Oxford Centre for Evidence-Based Medicine. The methodological quality of evidence was evaluated by use of the modified Coleman Methodology Score.⁶ Studies were considered excellent quality if they scored 85 to 100, good if 70 to 84, fair if 55 to 69, and poor if <55. The criteria for quality of RTP were based on the criteria of Zaman et al.²³ These consisted of RTP timeline, conditional criteria, measurement of conditional criteria, and rehabilitation protocol (timeline of immobilization postoperatively). A score of 4 indicated well-defined RTP criteria; 1 to 3, poorly defined criteria; and 0, no criteria. Clinical outcomes extracted and analyzed were (1) overall rate of RTP and return to previous levels, including overall rate, rate

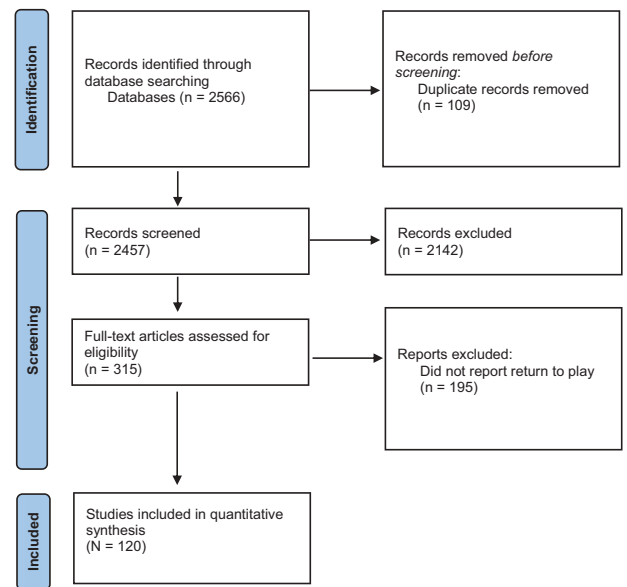


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) study selection flow diagram.

among collision athletes, and rate among overhead athletes; (2) time of RTP; and (3) RTP criteria.

Statistical Analysis

Quantitative statistical analysis was performed with SPSS (IBM Corp).

RESULTS

Literature Search

The initial literature search resulted in 2566 total studies. After removal of duplicates, the articles were screened for inclusion and exclusion criteria, and 2457 unique studies were evaluated and full texts assessed for eligibility. This review included 120 clinical studies (Figure 1).

Study Characteristics and Patient Demographics

Our review found 120 studies including 4327 cases that met our inclusion criteria. The mean methodological quality of evidence was 66.7. The majority of patients were male (80.2%), with a mean age of 37.2 years (range, 15-85) and

†Address correspondence to Eoghan T. Hurley, MB BCh, MCh, PhD, Duke University, 2301 Erwin Rd, Durham, NC 27705, USA (email: eoghanhurley@rcsi.ie).

*Sports Surgery Clinic, Dublin, Ireland.

‡Duke University, Durham, North Carolina, USA.

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TABLE 1
Study Characteristics and Patient
Demographics (120 Studies)

	Mean or % (No.)
Patients (n)	4327
Level of evidence	
4	85 (102)
3	7 (8)
2	5 (6)
1	3 (4)
Methodological quality of evidence	67 ^a
Quality of return-to-play criteria	
0	16 (19)
1	68 (82)
2	8 (9)
3	7 (8)
4	1 (2)
Male	30 ^a
Age, y	37 ^a
Follow-up, mo	35 ^a

^aMean.

TABLE 2
Level of Sport

Sporting Level	Studies	Patients
Recreational	14	469
Professional	14	110
Competitive	2	15

a mean follow-up of 34.5 months. A summary of study characteristics and patient demographics is shown in Table 1; full details can be found in Appendix 1 (available in the online version of this article). The majority of patients played sport at a recreational level (79%) (Table 2). Injuries most frequently occurred while cycling, followed by soccer, running, swimming, and volleyball (Table 3). Types of sport played were reported in 41/120 studies (34%).

Return to Play

The overall rate of RTP was 91.5%, with 85.6% of athletes returning to the same level of play. Among collision athletes, the rate of RTP was 97.3%, with 97.2% returning to the same level of play. In overhead athletes, the rate of RTP was 97.1%, with 79.2% returning to the same level of play. The mean time of RTP was 5.7 months (range, 1.5-15) (Table 4).

RTP Criteria

The overall RTP criteria were reported in the majority of the studies (83.3%); time to return to play was the most common item (83.3%). A wide discrepancy was found in

TABLE 3
Sports Played^a

Specific Sport	Patients
Cycling	246
Soccer	83
Running	71
Swimming	58
Volleyball	51
Weightlifting	44
Snow sports	40
Rugby	38
Mountain biking	31
Tennis	26
Handball	24
Basketball	18
Hiking	16
Dirt biking	16
AFL	15
GAA	9
Golf	8
Baseball	6
Yoga	6
Judo	6
American football	5
Triathlon	5
Surfing	4
Hockey	4
Wrestling	4
Horse riding	4
Squash	4
Ice hockey	3
Karate	3
Skateboarding	3
Boxing	2
Scooter	2
Javelin throwing	2
Badminton	2
Gymnastics	1
Rowing	1
Total	861

^aAFL, Australian Football League; GAA, Gaelic Athletic Association.

TABLE 4
Return to Play

Return to Play	Studies	Result, % (n/N) ^a
Total	49	91.5 (1434/1567)
Same/higher level	36	85.6 (917/1071)
Collision athletes		
Total	10	97.3 (72/74)
Same/higher level	8	97.2 (69/71)
Overhead athletes		
Total	6	97.1 (101/104)
Same/higher level	5	79.2 (38/48)

^an/N – Number that returned to play (n)/Total Number of patients in study (N).

TABLE 5
Return-to-Play Criteria^a

	No. (%)
Overall	100 (83.3)
Time	100 (83.3)
Time: NC/C	6 (5)
Imaging	1 (0.8)
Clinical examination/decision	3 (2.5)
Strength	11 (9.2)
Pain	4 (3.3)
Full range of motion	10 (8.3)

^aC, collision athletes; NC, noncollision athletes.

TABLE 6
Rockwood Classification

Rockwood Type	Patients
II	3
III	1663
IV	611
V	1724
VI	1
Total	4002

TABLE 7
RTP Rate by Rockwood Type^a

Type	Studies	RTP Rate, % (n/N) ^b
III	18	98.7 (401/406)
IV	10	82.6 (95/105)
V	19	96.2 (355/369)
III and IV	22	95.9 (563/587)
III and V	27	97.2 (775/797)

^aRTP, return to play.

^bn/N - Number that returned to play (n)/Total Number of patients in study (N).

TABLE 8
Mean RTP Time by Rockwood Type^a

Type	Studies	Patients	RTP Time, mo
III	7	94	4.9
IV	3	64	5.6
V	7	149	5.4
III and IV	14	324	5.6
III and V	16	274	5.1

^aRTP, return to play.

time of return, from 4 weeks to 12 months, with 6 months being the most frequently used time point (36%). Other criteria, including strength (9.2%), range of motion (8.3%), pain (3.3%) and radiographic assessment (0.8%), were less often noted. The mean score for quality of RTP criteria was 1.1 (range, 0-4) (Table 5).

Rockwood Classification

Patients most commonly experienced a Rockwood type III or V injury (n = 1663 and 1724, respectively), followed by type IV (n = 611) (Table 6). There were 0 type I injuries, 3 type II, and 1 type VI. High rates of RTP were seen in all Rockwood grades (Table 7). Rockwood type III had an RTP rate of 98.7%, with the mean timing of RTP for this group being 4.9 months (Table 8). Rockwood type IV had an RTP rate of 82.6%, with the mean timing being 5.6 months. Type V had an RTP rate of 96.2%, with the mean timing being 5.4 months. Some studies grouped types III and V and types III and V together. Outcomes from these studies can be seen in Tables 7 and 8. No RTP outcomes were reported on grades I, II, and VI.

Surgical Techniques

Various surgical techniques were used in the studies. These were grouped according to the meta-analysis by Bi et al³:

- Coracoclavicular screw fixation, such as the Bosworth or modifications
- Kirschner wire fixation of the AC joint with or without coracoclavicular fixation, such as the modified Phemister technique
- Hook plate
- Single-cortical button suture suspensory coracoclavicular fixation via an open or arthroscopic technique, using implants such as the TightRope or DogBone (Arthrex) or EndoButton (Smith & Nephew)
- Cortical button technique involving ≥2 clavicular tunnels
- Isolated graft reconstruction with either autograft or allograft
- Any cortical button suture suspensory coracoclavicular construct plus graft augmentation, such as the technique of Mazzocca et al¹³
- Any coracoclavicular reconstruction that incorporated AC joint reconstruction, such as the BiPOD (arthroscopically assisted bidirectional stabilisation) technique.

The cortical button technique involving ≥2 clavicular tunnels was the most commonly used and accounted for 26% of cases (Table 9). This technique had an RTP rate of 86.3% and a mean RTP time of 6.2 months. Kirschner wire fixation had the highest overall RTP rate (98.5%) (Table 10). The fastest RTP time was 3.6 months, as found in the isolated graft reconstruction technique (Table 11).

DISCUSSION

The most important finding of the study was that surgical treatment for AC joint dislocation provides a high rate of return to play, but there is a lack of criteria for clearing these athletes to RTP. However, when we examined level of RTP, we found significant differences between overhead

TABLE 9
Surgical Techniques Used^a

Surgical Technique	Studies	Patients
Cortical button technique with ≥ 2 clavicular tunnels	26	1126
Acromioclavicular joint reconstruction	25	858
Single-cortical button suture suspensory CC fixation: arthroscopic technique	19	675
Cortical button suture suspensory CC construct plus graft augmentation	11	288
Graft reconstruction	10	263
Kirschner wire fixation	3	183
Hook plate	6	155
Single-cortical button suture suspensory CC fixation: open technique	4	140
CC screw fixation	2	43
Mixed methods	14	596
Total	120	4327

^aCC, coracoclavicular.

TABLE 10
RTP Rate by Technique^a

Surgical Technique	RTP Rate (n/N)	RTP %	Studies
Kirschner wire fixation	67/68	98.50	2
Graft reconstruction	71/73	97.30	4
Cortical button suture suspensory CC construct plus graft augmentation	88/91	96.70	4
Acromioclavicular joint reconstruction	363/377	96.30	13
Hook plate	117/123	95.10	6
Single-cortical button suture suspensory CC fixation: open technique	76/84	90.40	3
Single-cortical button suture suspensory CC fixation: arthroscopic technique	308/351	87.70	9
Cortical button technique with ≥ 2 clavicular tunnels	327/379	86.30	11
CC screw fixation	17/22	77.30	1

^aCC, coracoclavicular; RTP, return to play.

n/N - Number that returned to play (n)/Total Number of patients in study (N)

TABLE 11
RTP Time by Technique^a

Surgical Technique	RTP Time (mo)	Studies	Range	Studies
Graft reconstruction	3.6	4	3-4	4
Acromioclavicular joint reconstruction	4.4	11	2-9	11
Single-cortical button suture suspensory CC fixation: arthroscopic technique	5.1	5	2-10	5
Hook plate	6	3	6-6	3
Cortical button suture suspensory CC construct plus graft augmentation	6	1	6-6	1
Cortical button technique with ≥ 2 clavicular tunnels	6.2	6	3.3-12	6
Kirschner wire fixation	6.7	3	1.5-15	3
Single-cortical button suture suspensory CC fixation: open technique	8.1	3	6-12	3

^aCC, coracoclavicular; RTP, return to play.

and collision athletes. Almost all collision athletes returned to their preinjury levels of sport, whereas over one-fifth of overhead athletes did not return to the same level. The most frequent criteria were based on timing, but several studies reported assessment of strength and range of motion as conditional criteria that had to be met before RTP could be allowed safely.

The overall rate of RTP was high after surgical fixation of the AC joint. This compares favorably to the findings of other systematic reviews: Verstift et al²¹ reported a 94%

rate of RTP among 432 patients in 12 studies, and Kay et al¹⁰ cited rates of return to any level of sport between 94% and 100% among 315 patients in 12 studies. Similarly, we found that the majority of patients (86%) returned to their preinjury levels of sport. Verstift et al and Kay et al had findings in keeping with this, reporting return to preoperative level of play of 84% and 88%, respectively; however, the reasons behind non-RTP were not noted. These are most likely broad ranging and subjective. Factors other than physical limitation attributed

to shoulder injury may play a role, such as changes in lifestyle, decisions to retire from professional sport, and fear of reinjury. These may influence the rates and levels of RTP and should be analyzed in future research in this area.

Return-to-sport rates were consistently high in the literature among collision and overhead athletes. The randomized controlled trial by Müller et al¹⁵ revealed an RTP rate between 93% and 100% at 24 months. Porschke et al¹⁸ studied RTP outcomes after anatomic AC joint stabilization in overhead versus nonoverhead athletes. They found that 27% of overhead athletes had to reduce their levels to low-demand sports, whereas none of the nonoverhead athletes lowered their levels.

As mentioned, AC joint dislocations are classified into 6 categories based on the Rockwood classification. Types I and II are generally managed nonoperatively while types IV to VI require surgical treatment, with controversy surrounding the treatment of type III dislocations. Our study compared the rates and timing of RTP based on the Rockwood classification. High rates of RTP are seen in throughout all Rockwood grades. Similar rates of RTP can be seen in systematic review by Verstift et al.²¹ Timing of RTP varied by Rockwood classification. With regard to timing of RTP, type IV had the longest time. The data presented in this study comparing Rockwood grades are valuable clinically to help guide surgeons in their practice and help to inform patients of what they can expect postoperatively. However, it must be noted many studies grouped patients into clusters and examined their outcomes as such. In these studies, outcomes were not recorded for each Rockwood classification. This somewhat limits our ability to compare outcomes among the Rockwood grades. Nonetheless, useful data can be extrapolated by the information presented. Further work in this area comparing outcomes for each Rockwood type would be very advantageous to surgeons in guiding clinical practice.

There are >150 variations described in the treatment of AC joint dislocations²; however, there is no clear evidence to suggest which has superior outcomes in terms of RTP. As stated, the most commonly employed method was the cortical button technique involving ≥ 2 clavicular tunnels. This offers a high rate of RTP and does not require sacrifice of the coracoacromial ligament. Kirschner wire fixation provided the highest rate of RTP but has the disadvantage of requiring a second operation. Excluding screw fixation, all techniques had an RTP rate >86%. Isolated graft reconstruction was associated with the fastest RTP time. This is in keeping with the findings of Kumar et al,¹² who reported earlier levels of RTP and work in patients treated with a synthetic ligament for AC joint reconstruction when compared with the modified Weaver-Dunn procedure. It is worth noting that the number of patients in this study treated with Kirschner wire and isolated graft reconstruction ($n = 183$ and 263 , respectively) is far less than that treated with a cortical button technique involving ≥ 2 clavicular tunnels ($n = 1126$).

Criteria for safe RTP lacked detail in most studies. Furthermore, this was not the primary focus of the studies. The majority reported only time-based criteria, most

commonly 6 months. Just 1 study employed the use of imaging to assess bony union as a measure for determining safe RTP.⁴ Encouragingly, the authors cited no incidences of recurrence of instability. Thus, the use of imaging alongside other conditional criteria, such as clinical evaluation, could play a role in determining when safe RTP should be allowed. Many of the studies followed similar rehabilitation protocols postoperatively. However, owing to a lack of comparison groups among patients, it is difficult to make any conclusions on what is safe as far as criteria for RTP. Ciccotti et al⁵ and Hurley et al⁹ previously identified 7 criteria to determine when patients are ready to RTP after surgical stabilization for traumatic anterior shoulder instability. These include time from surgery, strength, range of motion, pain, stability, proprioception, and postoperative radiograph evaluation. Development of validated criteria for safe RTP after surgical treatment for AC joint dislocation could reduce the rate of recurrence and improve patient outcomes.

The findings of this study have significant implications for patients and clinicians. The current study found that return-to-sport rates after surgical treatment for AC dislocation is similar to that for other shoulder operations, such as rotator cuff repair (85%),¹¹ arthroscopic Bankart (81%),¹⁴ and Latarjet procedures (89%).⁹ This is particularly relevant as it can aid surgeons when counseling patients and their parents about the realistic rates, timing, and level of RTP that can be expected after this type of surgery. However, further study is needed regarding RTP outcomes after surgical treatment for AC joint dislocation. Prospective literature comparing RTP outcomes of the various techniques used for this procedure is lacking. Additional subgroup analysis comparing how RTP outcomes differ in acute versus chronic dislocations and return to specific sports would provide greater insight. Future research should also incorporate information on athletes' sporting activity, frequency, and intensity to accurately assess return-to-sport outcomes.

Limitations

This study has potential limitations and sources of biases, including the limitations of the studies themselves. The majority of studies provided uncontrolled level 4 evidence, which may introduce selection bias. Given the reporting limitations in the studies, we were not able to analyze demographic factors as potential risk factors for inability to RTP. Finally, various types of surgical procedures were used across the studies, making a somewhat heterogeneous group.

CONCLUSION

The overall rate of RTP was reportedly high after surgical treatment for AC joint dislocation, with the majority of patients returning to their preinjury levels of sport. There is a lack of consensus in the literature for what constitutes a safe RTP, with further focus on this topic required in future studies.

ORCID iDs

Eoghan T. Hurley  <https://orcid.org/0000-0002-7696-2981>

Martin S. Davey  <https://orcid.org/0000-0002-3229-6032>

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