

Case Report

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Grade III Acromioclavicular Dislocation in an Elite Male Lacrosse Player - Case Report

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ABSTRACT

Background: Dislocations of the acromioclavicular joint have been frequently reported in collision and contact sports such as American football and rugby. Traumatic acromioclavicular joint injuries also account for the most frequent occurring shoulder injury in men's colligate lacrosse by the National Collegiate Athletic Association. Consensus exists on the conservative management of low-grade injuries, whilst equipoise remains on the management of dislocation in contact athletes. Despite increasing popularity of lacrosse and increasing number of epidemiological injury surveillance, little evidence exists to guide sports specific rehabilitation and effective return to play.

Purpose: This paper describes the case of an elite level male lacrosse player managed conservatively with a grade III acromioclavicular dislocation.

Study Design: Single patient case study.

Methods: Descriptive case report of the rehabilitation and return to play decisions.

Results: Grade III dislocations of the acromioclavicular joint can be managed with or without operative intervention. Rehabilitation programmes following this injury need to be tailored to the complex movement needs of the athlete's sport, the addition of direct contact in lacrosse collisions needs to be considered in athletes returning to this sport. With a structured rehabilitation programme addressing all aspects of the sport a player can safely return to elite level lacrosse competition without surgical intervention.

Conclusion: Conservative management of a grade III/IV acromioclavicular joint injury can allow safe return to lacrosse in a timely manner.

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What is Known about the Subject: This is the first report of a rehabilitation programme for an acromioclavicular joint dislocation specifically tailored to lacrosse. Previous studies have looked at this injury in both rugby and American football.

What this Study adds to Existing Knowledge: Male athletes can safely return to elite lacrosse without operative intervention following a grade III ACJ dislocation.

Introduction

Lacrosse is the oldest team sport in North America, with documentation of native American tribes playing in the early 12th century. Modern day lacrosse has 3 formats (field, box and sixes) each involve 2 teams attempting to score a goal by getting the ball into the opponent's net. The sport is gaining international popularity, with over 1.1 million registered athletes, 90 National federations, and 2.5 million recreational players in America alone. Following the announcement of the men's and women's game at the 2028 Olympic games, further interest and participation is predicted [1].

Lacrosse is a physically demanding sport [2]. Required upper limb tasks involve repeated passing and overhead throwing of the ball using a carbon fibre, aluminium, or titanium stick, as well as using the arm to defend during contact. Relatively unique to lacrosse is the potential for a direct strike to the shoulder from an opposing players stick, as well as an in-direct trauma following a diving maneuver onto the shoulder or elbow to improve a shooting opportunity [3].



Figure 1: Example of the Extreme Shoulder Positions Required for Shooting in Lacrosse

Similar to football and rugby, lower limb tasks involve running, sprinting, twisting, turning and as with the upper limb, can include direct trauma/ blows from stick and opponents.

A recent meta-analysis of over 17, 000 all age and ability male lacrosse players, reported lower limb, head and chest, were more frequently injured comparative to the shoulder [4]. At the 2018 world championships, the shoulder did however account for between 7-9% of all injuries in senior men's lacrosse, at a rate of 1.89 per 1000 athletic competitive exposure hours [5]. The acromioclavicular joint was the most common site of shoulder injury in male collegiate lacrosse (57% of all shoulder injuries) over a 5-year surveillance, caused mainly by a direct blow. Despite this, little evidence exists to guide the specific management of traumatic ACJ injuries in lacrosse players [6]. It is commonly accepted however that management of traumatic ACJ injuries can be guided by combining clinical findings and the Rockwood Classification [7]. This classification uses radiographic imaging to grade injury severity from I -VI. Grade I-II injuries are usually managed conservatively, whilst grade IV-VI are commonly managed surgically. The management of grade III injuries remains controversial [8, 9].

This case report describes the assessment, management, rehabilitation and return to play of an international male lacrosse player with a traumatic grade III acromioclavicular joint dislocation.

Case Report

History

A 27-year-old right hand dominant elite male lacrosse player presented to the Emergency Department (ED) after sustaining a direct blow to the left antero-lateral shoulder from a titanium lacrosse stick.

Severe pain was localised to the left acromioclavicular joint (ACJ) immediately following the trauma and was therefore removed from play. On arrival at ED the pain had become more diffuse and was reported as a constant severe ache globally around the shoulder, radiating superiorly into the left lateral cervical spine and upper trapezius and inferiorly to the anterolateral upper arm.

Physical Examination

On inspection of the affected left shoulder, ecchymosis and abrasion was noted in the area. The left scapula was slightly depressed, the glenohumeral joint was internally rotated across the waist, and the flexed left elbow was supported by the right hand. A "step deformity" was observed at the left ACJ (DeGroot et al. 2023) (see figure 2).



Figure 2: Observation of 'Step Deformity' in the Left Shoulder and Slight Scapula Dyskinesia

Direct palpation of the left ACJ was exquisitely tender and subjectively reproduced pain experienced at time of injury. Palpation of the upper trapezius, deltoid, and lateral neck musculature was tender but not severe.

Active movement of the left shoulder in all planes was grossly limited secondary to pain but not pseudo paralytic. Passive movements of the glenohumeral joint, including external rotation, revealed sufficient mobility to reduce clinical suspicion of glenohumeral dislocation [10]. Active movements of the cervical spine were uncomfortable but well maintained and did not reproduce radicular arm pain.

Neurovascular examination, including reflex testing of the upper limb was normal. Isolated active movements of abduction, and lateral rotation were noted to be weaker than the unaffected right shoulder but remained 5/5 on the Oxford scale.

The notable inferior displacement of the acromion in relation to the distal clavicle was amenable to passive reduction indicating ligamentous failure of the acromioclavicular and coracoclavicular ligaments but that the clavicle was not constrained within the deltotrapezial fascia [8].

Pain limited further testing of the shoulder complex and a clinical diagnosis of a traumatic ACJ injury was made.

Radiological Imaging

Radiographic examination of the left ACJ was requested to confirm diagnosis, classify, and exclude concomitant bony injury, such as acromion or coracoid fracture [7]. Three views were requested and subsequently performed in radiology. Anteroposterior, modified axillary, and a Y-view. The patient was unable to tolerate ACJ stress views.



Figure 3: Imaging of the Left Shoulder taken on the day of Injury

Diagnosis

Based on radiographic imaging and clinical assessment, a Grade III ACJ dislocation was confirmed and described to the individual by a Consultant Orthopaedic Shoulder and Elbow Surgeon. Given the scapula dyskinesia present at this clinic appointment the more recent classification would be IIIB [11].

Shared Decision Making/ Non-Surgical Management

Known risks and benefits of surgical and non-surgical management options were discussed, including current equipoise in 'best' evidence-based management. Following an informed, and shared

decision-making process, including understanding the individual’s unique circumstances and goals, the decision for non-surgical management was jointly made. A broad arm sling was provided, and an Orthopaedic review booked for six-weeks post injury. The individual was informed that review would include clinical and radiographic assessment to help guide further management.

Rehabilitation

The injury occurred on the last field lacrosse club game of the season. In England, the sixes tournament, ‘the fly’, follows on from the end of the club season. Despite being drafted, the patient withdrew as the tournament was played across three weekends within the following six-week review period. The amateur athlete however continued his profession as an accountant with rehabilitation undertaken outside of occupational hours. The rehabilitation was outlined and planned with a structured program, progressing activities based on tolerance and pathophysiological healing time frames.

Table 1: Rehabilitation Program and Principles of Each Stage

Timeline	Goal	Treatment
Phase 1 Immobilisation 0-10 days	Acute inflammation settles and proliferation begins	Sling for comfort. Analgesia PRN. Elbow, wrist, hand ROM exercises. Utilise hand and elbow for ADLs Isometric cuff strength as pain allows. Scapula control exercises Vitamin D 4000 iu.
Phase 2 Range of motion and early strengthening 10 days to 3 weeks	All activities below 90° Avoid cross adduction Avoid marked protraction Comfortable ‘safe zone’ Closed kinetic chain work.	Proprioception & gentle weight bearing in kneeling or on table. Closed chain scapula control work Posterior cuff through controlled range Basic controlled stick skills in neutral zone.
Phase 3 Strengthening 4-6 weeks	Regain full ROM Controlled strength work through range	Controlled movement in functional position, full range strength work. Soft tissue release to regain full ROM Weight bearing work, double and single arm with scapula control. Build resistance with all strength work.
Surgical Consultation and isokinetic strength testing.		

Phase 4 Advanced rehab and return to play 6-12 weeks	Return to full strength Regain full control of all movements Push into fatigue Stress ACJ Develop pre-game ‘prehab’ regime for scapula control.	Plyometrics, up to full weight bearing. Lacrosse control with left hand. Functional strength with resistance including sport specific movements. Boxing to fatigue. Upper limb SAQ work Direct contact using tackle pads. Functional movements landing on left side. Sport specific activities.
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Rehabilitation Phases

Phase 1

Post clinical assessment, the affected shoulder was immobilised in a broad arm sling for a period of ten days. This protective period is to ensure that the affected tissue is not further stressed, and the early stages of healing are promoted. Tendon healing after acute injury occurs in three distinct phases; inflammatory, proliferative, and remodelling. During inflammation the overall tissue strength of a wound is minimal, and therefore a period of immobilisation may reduce disruption and encourage early ‘scaffolding’ necessary to support and rebuild the damaged tissue [12].

Mobilisation of the hand, wrist, and elbow was encouraged to ensure range of movement and the neuromuscular control pathways were maintained. Low grade pain free isometric rotator cuff exercises were performed, including some gentle scapular retraction exercises. The patient followed the prescribed analgesia regime and was encouraged to return to an adapted gym routine, including lower limb and the use of the unaffected upper limb.

Phase 2

During stage two, the proliferation stage, or rebuilding stage, was considered. This process is said to occur as early as 24 hours post injury and may last up to three weeks [13]. The immature and disorganised tissue can be vulnerable to excess loading whilst gentle loading, seen in tendon studies (Eliassion), can be beneficial. The patient was advised that the sling could be removed for progressively prolonged periods of time both at rest and mobility, till there was minimal discomfort without its use.

The resting position of the scapula position was highlighted to the patient and awareness made to focus on scapular retraction to neutral where possible with the theory of unloading the structures around the acj when protraction and depression occurs. Exercises such as the Low row were performed in standing with minimal protraction advised in the early stages.

Closed chain supported range of movement was completed. Closed kinetic chain exercises have been shown to facilitate co-contraction of the rotator cuff and reduce scapula dyskinesia [13]. Forward flexion and abduction greater than 90dg and horizontal adduction however were discouraged. Three dimensional ACJ motion studies have shown movement at the ACJ increases with elevation and overriding of the clavicle on the acromion occurs when abduction occurs above 90dg and with internal rotation at the glenohumeral joint (Oki, 2012, 2013). Gentle weight transfer through the hands

in kneeling was commenced to improve proprioception, control, and gentle loading of the rotator cuff and periscapular musculature.

Towards the end of stage two, control of the shoulder complex was prioritised to improve the scapula and glenoid motion [13]. Right-handed basic individual stick skills were introduced within the ‘safe zone’ advocated by Funk and colleagues (???), to reduce excessive loading on the ACJ. Exercises such as the bent over reverse fly, lawnmower, and robbery were introduced to aid activation of the posterior superior rotator cuff, deltoid, rhomboids, and trapezius [14].

Phase 3

A recently published consensus meeting suggested full range of movement should not be developed until 6 weeks [11]. At week four, the patient was comfortable with all but terminal end of range flexion, and the combined movement of flexion, abduction and external, (FABERS) or internal rotation (FABIRS). Lacross requires excellent lower limb, trunk, and upper limb movement and control to generate large forces during overhead shots. Open chain, including resisted exercises incorporated the kinetic chain to encourage the development of serratus anterior, trapezius, and periscapular musculature whilst engaging the core and trunk rotation. Closed chain exercises progressed to kneeling press positions and push up plus exercises initially in standing. Greater focus was placed on technique, ensuring even weight distribution and acceptance.

By week five the patient had full active range of movement. Best practice guidance in New Zealand suggest pain free full range of movement should be achieved prior to sport specific training. Right-handed sport specific drills were increased although throwing and catching on the affected left side was introduced to encourage proprioception and re-engage existing cortical mapping pathways.

Phase 4

Open chain dynamic strength training work was introduced such as overhead push press, Turkish get ups, and clean and jerk. Progressive loading was programmed for a six-week duration and functional movements for lacrosse were identified and incorporated into strength training sessions. Weight bearing work continued and was built into the warm-up for each rehab session. High volume with minimal rest was programmed so muscle fatigue and high effort was achieved with low resistance.

Proprioception is a hugely important factor in lacrosse and return to play. Where possible the lacrosse stick was incorporated into rehabilitation. Left-hand control returned quickly, Boxing against pads was used to work on control, speed and endurance in both upper limbs. The individual also took the position of holding the pads and working on more eccentric and deceleration upper limb control. The effort and timings were increased as confidence improved. Power

is essential for shooting in lacrosse. Resistance bands were initially used to create resistance against sport specific functional movement but later progressed to field work.

Direct shoulder contact and landing on the left side was introduced, initially with tackle pads but removed as confidence improved and movements recreated in practice. Once all goals were achieved the athlete was able to begin training with the added uncertainty of other players.

Imaging During Rehabilitation and First Clinical Review

At 6-weeks post injury the patient attended for surgical review. Imaging revealed no further displacement at the ACJ (figure 4,7). Range of movement was almost full, and pain was present only with ACJ stress testing and abduction with external rotation, this furthered the classification to Rockwood IIIB [14]. The shared decision was to continue rehabilitation.



Figure 4: AP X Ray of Shoulder at 6-Weeks Post Injury



Figure 5: ACJ X Ray of Shoulder with 20-Degree Cranial Tilt at 6-Weeks Post Injury

Testing

Isokinetic strength testing was completed at 6-weeks post-injury to ensure the rehabilitation could be focused on the patient’s needs. Tests were completed in the modified neutral position and the movements measured were internal and external rotation. The patient is right-hand dominant, which may account for some discrepancy up to 10%.

Table 2: Isokinetic Strength Testing in Modified Neutral Position at 60°/Second

60°/second 5 reps of each	External Rotation			Internal Rotation		
	Right	Left	Deficit	Right	Left	Deficit
Peak torque (ft-lb)	16.4	16.0	2.4%	31.0	31.1	-0.3%
Angle of peak torque (deg)	80	14		74	48	
Peak torque % of bodyweight	9.1	8.9		17.2	17.3	
Max rep total work (ft-lb)	26.3	17	35.3%	47	45	4.1%
Average power (watt)	15.1	10.7	29.1%	28.1	29.7	-5.7%
Total work (ft-lb)	117.9	74.3	37.0%	218.2	201.8	7.5%

The isokinetic strength testing showed that internal rotation at low speeds was strong on the left side. Although the peak torque of internal rotation at this slow speed was high, the overall work showed fatigue in the external rotators over the 5 repetitions.

Table 3: Isokinetic Strength Testing in Modified Neutral Position at 180°/Second

180°/second 10 reps of each	External Rotation			Internal Rotation		
	Right	Left	Deficit	Right	Left	Deficit
Peak torque (ft-lb)	12.6	8.7	31%	30.2	25.1	16.9%
Angle of peak torque (deg)	20	16		67	76	
Peak torque % of bodyweight	7	4.8		16.8	14	
Max rep total work (ft-lb)	14.9	7.4	50.7%	47.5	31.3	34.1%
Average power (watt)	17.7	6.5	63.2%	48.6	43.8	9.9%
Total work (ft-lb)	114.9	39.5	65.6%	325.4	248.5	23.6%

Assessment with increased rotation velocity revealed the overall motor output, both the power and peak torque on the affected left shoulder were reduced comparative to the right. The deficits noted may also be exacerbated by repeated functional tasks required in lacrosse and therefore improvement of these elements is required before a return to play is considered. Rehabilitation prior to this point had focused on slow controlled movements, and therefore this finding was expected.

Discussion

Despite the prevalence of acromioclavicular joint dislocation in the sporting population increasing over the last 20 years, the debate of surgical and non-surgical management of such injuries continues [11, 15].

A Cochrane review of surgical versus conservative intervention for adult ACJ dislocation concluded that surgical treatment had no additional benefit in terms of function, return to former activities, and quality of life at one year compared to conservative intervention [9]. Conservative intervention however primarily involved sling immobilisation, with little or no information provided on rehabilitation. Based on low quality evidence, the authors highlighted conservatively managed individuals had greater function compared to their surgical counterpart at six weeks which was in keeping with our findings of improved function at six weeks post injury.

Surgical intervention across the trials also resulted in a higher number of adverse events. The authors suggested that individuals should not simply consider the risks of surgery but that of the potential for persistent symptoms with conservative options. It should however be highlighted that the surgical stabilisation methods adopted in some of the trials, such as K-wire and Hook plate, are now infrequently used due to their risk profile and potential for secondary surgery. Despite over 150 ACJ surgical stabilisation methods recorded in the literature, no gold standard exists. A recent network meta-analysis concluded that the addition of acromioclavicular ligament fixation likely improved functional outcomes, reduced recurrence rate at final follow-up, but at the expense of longer operative times.

Within the literature, conservative/ non-surgical management frequently involved the use of a sling for a specified duration before progression to assisted and then active movement of the affected shoulder. When reported, duration and activity within these 'phases' is variable across trials and may simply be down to individual therapists and teams, not evidence. A retrospective study of grade III and higher-grade injuries advocated immobilisation and strength training at six and twelve weeks respectively, whilst an RCT advised, as little as ten days, and 6 weeks [16].

Although case series comparing surgical and non-surgical management of grade III ACJ exist, little is known about the

frequency and type of exercises that should be advised and when [14]. To date, no randomised controlled trial has compared the effectiveness of one rehabilitation method or protocol versus another for acromioclavicular dislocation, nor is there a consensus or 'gold standard' [13]. Kibler, et al. conducted a review of the literature in which surgical and non-surgical outcomes of ACJ injuries were documented between 1972 and 2021 [14]. Although 28 studies involved the use of non-surgical management, only one provided sufficient and specific details of the exercise management prescribed/ delivered [17]. With little evidence to guide clinicians, it is possible that clinicians may find rehabilitating such injuries, challenging, and that future consensus work, both on surgical and non-surgical management may help future trials to be more meaningful.

The evidence base in the rehabilitation of grade III ACJ injuries appears to be lacking. Although static stability of the ACJ is no longer maintained, the dynamic stability globally around the joint is likely to be provided by the overlying trapeziodeltoid complex and adjoining musculature. A review of 46 patients with AC joint separations reported 94% had injury to the trapezius and/or deltoid [18]. To encourage a compensated shoulder the rehabilitation should incorporate the surrounding musculature such as the periscapular group, serratus anterior, and trapezius. NZ best practice suggests the strength should be between 75% to full strength, compared with contralateral shoulder prior to returning to sport specific activities [19].

A benefit of non-surgical management is a quicker return to activities of daily living comparative to surgical intervention. In the sporting cohort this is very important, as to is the reduced risk of adverse events, including the possible periprosthetic fracture around stabilisation hardware seen in contact sports [11]. Non-surgical management of grade III ACJ dislocation is also cost effective and can begin immediately post injury. A recent prospective multi-centre observational cohort study of acute severe ACJ injuries also highlighted that it is a patient's preferred choice, with 61% of the participants expressing a wish for conservative management (CONRET Group). Should non-surgical management be unsuccessful in reducing pain and instability then conversion to surgery later does not appear to affect surgical outcomes [11]. The rehabilitation programme described in the case described allowed an elite male athlete to return to international lacrosse without the need for surgical intervention [20].

Limitations

As with any single patient case study the results cannot be generalised to all grade III ACJ dislocations.

No long-term follow-up data is available for this individual with final follow up conducted at six months post injury. This lack of data means we are unable to identify if this patient later converted to surgical intervention.

The exercise prescription and ‘phases’ were introduced based on clinician experience guided by the existing evidence base, and therefore subject to bias.

Conclusion

A twelve-week rehabilitation programme enabled a lacrosse player with an acute traumatic ACJ grade III injury to return to the field of play safely and confidently. Rehabilitation was guided by tissue healing time frames and individualised to the complaints and goals of the individual, not simply time.

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