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Original Research Article

Acromioclavicular Joint Reconstruction: A Comprehensive Review of Operative Modalities and a Retrospective Analysis of Suture Anchor Fixation

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Abstract: ***Objectives***: Acromioclavicular (AC) joint disruptions are common shoulder injuries, often requiring surgical intervention for high-grade (Rockwood types IV and V) instability. Traditional fixation methods, such as K-wire stabilization, are associated with high complication rates, including hardware migration and post-traumatic arthritis. This study aims to detail an anatomic surgical technique utilizing suture anchor fixation and evaluate its clinical and functional outcomes. ***Materials and Methods***: A retrospective analysis was conducted on 10 consecutive patients (mean age 32 years) with acute Rockwood Type IV or V AC joint dislocations treated at a tertiary care center in Bangalore. All patients underwent reconstruction using suture anchor fixation supplemented by coracoacromial (CA) ligament transfer. Functional outcomes were assessed using the Constant-Murley Shoulder Score (CMS), and maintenance of reduction was monitored through standardized radiographic protocols. ***Results***: The mean follow-up duration was 12 months (range: 9–23 months). Immediate postoperative radiographs confirmed anatomical reduction in 100% of cases. At final follow-up, the mean Constant-Murley score was 93.2, with 80% of patients achieving full, unrestricted range of motion. Complications were limited to two superficial wound infections; notably, no instances of hardware migration, neurovascular injury, or secondary AC joint arthrosis were observed. ***Conclusion***: Suture anchor fixation, combined with CA ligament transfer, provides a stable, non-rigid construct that effectively restores the anatomy of the AC joint. This technique avoids the catastrophic risks associated with metallic hardware migration and offers excellent functional recovery, making it a viable alternative to traditional transarticular fixation.

Keywords: Acromioclavicular Joint, Joint Dislocation, Suture Anchors, Coracoclavicular Ligament Reconstruction, Rockwood Classification, Constant-Murley Score, Orthopaedic Surgery, Ligament Transfer.

INTRODUCTION

The acromioclavicular (AC) joint is a plane-type, diarthrodial synovial joint that connects the lateral clavicle to the acromion of the scapula. As a crucial component of the anterior shoulder, it anchors the scapula to the thorax, primarily facilitating gliding motions alongside limited axial and anteroposterior movements. AC joint disruptions account for approximately 20% of all shoulder injuries and typically result from a direct impact to the lateral acromion with an abducted arm, or from falling onto an outstretched or adducted extremity.

Treatment algorithms are heavily guided by the severity of the injury. Conservative, non-operative

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management is the established standard for Rockwood types I, II, and III. Conversely, surgical stabilization is highly recommended for high-grade injuries (Rockwood types IV and V) to prevent chronic weakness, deformity, and disabling pain.

Surgical intervention generally relies on one of three foundational techniques: acromioclavicular fixation, coracoclavicular reconstruction, or dynamic muscle transfer. These approaches are often supplemented with distal clavicle resection or ligament augmentation. For coracoclavicular reconstructions, while tendon autografts and allografts are sometimes utilized, the transfer of the coracoacromial ligament remains the most common method.

Historically, securing the AC or coracoclavicular joint involved hardware such as smooth pins, threaded pins, screws, and cerclage wires. However, these devices are associated with severe complication profiles. Rigid implants can lead to degenerative joint disease, hardware breakage, and life-threatening migration of pins or wires into the lungs, heart, or major blood vessels. Dynamic muscle transfers have also presented unique postoperative challenges. Furthermore, cerclage materials like stainless steel wire or Dacron tape can gradually erode through the bone over time, effectively amputating the coracoid process or clavicle and causing a complete loss of reduction.

To address these significant risks, the use of suture anchors has emerged as a promising alternative. Suture anchors can minimize the risk of neurovascular injury associated with passing sutures completely around the base of the coracoid. Additionally, they circumvent the need for subsequent hardware removal surgeries and demonstrate a markedly lower risk of implant breakage or migration. Therefore, the objective of this study is to detail the surgical technique utilizing suture anchors and to evaluate the preliminary clinical outcomes in a series of 10 consecutive patients.

AC Joint Repair with K-Wires (Transarticular Fixation)

Historically popularized by Phemister (often referred to as the modified Phemister technique), this method involves direct stabilization of the AC joint space. While once the standard of care, its use in modern orthopaedics has significantly declined due to severe complication profiles.

Surgical Technique:

Exposure: A transverse or saber-cut incision is made directly over the AC joint. The joint is debrided of the disrupted intra-articular meniscus disc and hematoma.

Reduction: The distal clavicle is manually reduced downward, and the acromion is elevated to restore anatomic alignment.

Pin Placement: While holding the reduction, one or two stout K-wires (typically 2.0 mm or 5/64-inch) or fully threaded Steinmann pins are driven from the lateral edge of the acromion, completely across the AC joint space, and directed medially into the medullary canal of the distal clavicle.

Pin Bending/Augmentation: The lateral ends of the K-wires protruding from the acromion must be bent sharply. As seen in your previous radiograph, this is frequently augmented with a figure-of-eight tension band wire looped around the bent K-wires and passed through a drill hole in the clavicle.

Biomechanical Principles & Complications (Per Standard Texts):

The "Rigid" Flaw: The normal AC joint is a dynamic, diarthrodial joint that rotates and glides during shoulder abduction and elevation. Fixing a mobile joint with rigid, straight metal pins subjects the pins to massive cyclical bending forces.

Hardware Failure: Due to these fatigue forces, K-wires and pins are highly prone to bending, breaking, or backing out.

Catastrophic Migration: The most feared complication is the medial migration of unbent or broken K-wires into the thoracic cavity, piercing the pleura, lungs, spinal canal, or major cardiovascular structures.

Post-Traumatic Arthritis: Transarticular penetration of the articular cartilage almost guarantees secondary degenerative AC joint arthrosis, usually necessitating eventual distal clavicle excision.

Coracoclavicular (CC) Reconstruction with Endobutton

Because of the limitations of rigid transarticular fixation, modern standard textbooks strongly advocate for reconstructing the coracoclavicular (CC) ligaments (the conoid and trapezoid). The "Endobutton" technique (a type of cortical suspensory fixation) has become a gold standard for this.

Materials and Methods

Patient Cohort and Demographics -

A consecutive series of 10 patients (comprising both males and females) presenting with acute Rockwood Type IV and V acromioclavicular (AC) joint dislocations were surgically managed at KIMS Hospital, Bangalore. The patient cohort had a mean age of 32 years (range, 19–46 years). The mechanisms of injury varied, encompassing sports-related trauma, simple falls, and motor vehicle collisions. All patients underwent AC joint reconstruction utilizing suture anchor fixation. The mean interval from the time of injury to surgical intervention was 11.5 days (range, 5–15 days).

Preoperative Setup

Following the induction of general anesthesia, a routine examination under anesthesia (EUA) was performed to document the affected shoulder's baseline range of motion, degree of instability, and the manual reducibility of the AC joint. Patients were subsequently placed in the standard beach-chair position, and the operative upper extremity was prepped and draped in a sterile fashion.

Surgical Technique

A 7-cm strap incision was made corresponding to Langer's lines. The incision was initiated 2.5 cm posterior to the clavicle, crossed the clavicle 2.5 cm medial to the AC joint, and extended distally to terminate just medial to the tip of the coracoid process. The deltotrapezial fascia was elevated subperiosteally from both the distal clavicle and the anterior acromion. The deltoid muscle was then retracted anteroinferiorly to achieve adequate exposure of the coracoid base.

To optimize the biological healing environment, the anterior cortical surface of the distal clavicle was deliberately decorticated. Two transosseous drill holes were subsequently created through the clavicle, directed from anteroinferior to posterosuperior. The limbs of the anchor sutures were passed through these tunnels, with the free ends exiting posterosuperiorly. The coracoacromial (CA) ligament was then harvested and transferred alongside a block of acromial bone. Following the anatomical reduction of the AC joint, this bone block was rigidly secured to the prepared, decorticated bed on the distal clavicle utilizing the suture anchors. The procedure concluded with the meticulous reattachment of the deltotrapezial fascia to the clavicle, followed by routine skin closure.

Postoperative Rehabilitation

Immediately following surgery, the operative extremity was immobilized in a sling for a period of 4 to 6 weeks. Gentle passive pendulum exercises were introduced at 3 weeks postoperatively. By the sixth week, patients were transitioned into a structured physical therapy protocol emphasizing progressive range of motion and gradual strengthening. To protect the healing reconstruction, heavy lifting and high-resistance exercises were strictly prohibited for the first 3 months postoperatively.

Clinical Evaluation -

Patients underwent standardized clinical assessments at minimum postoperative intervals of 6 weeks, 3 months, and at their final follow-up visit. Functional outcomes were quantified utilizing the Constant-Murley Shoulder Score. In addition, a comprehensive clinical profile was documented for each patient, capturing data on occupational status, hand dominance, the specific date and mechanism of the trauma, any prior history of shoulder pathology, current range of motion, neurological status, and the timeframe required to return to work.

Radiographic Evaluation

Imaging protocols included standard anteroposterior (AP) radiographs of the general shoulder as well as dedicated AP views of the AC joint. To assess the maintenance of the surgical reduction, the vertical distance between the clavicle and the inferior border of the acromion was measured and compared to the uninjured, contralateral side. The degree of reduction loss was categorized based on this side-to-side discrepancy:

Anatomical reduction: < 2 mm difference
Slight loss of reduction: 2–4 mm difference
Partial loss of reduction: 4–8 mm difference
Total loss of reduction: > 8 mm difference

Furthermore, all follow-up radiographs were systematically reviewed for the development of any postoperative degenerative changes within the AC joint.

Constant Murley Score (CMS)

Patient name: ______ **Dominant hand:** ◯ Right ◯ Left ◯ Both

Date: ______ **Affected arm:** ◯ Right ◯ Left

A. Pain score

Indicate the highest pain level you have experienced in your shoulder during ordinary activities within the last 24 hours. To do this, set a mark on the line.

◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯

No pain — Intolerable pain

B. Activities of daily living

The next 4 questions deal with everyday activities you experienced over the last week.

1. Is your sleep disturbed by your shoulder? (Please tick only one box)

◯ Undisturbed sleep (+2) ◯ Occasional disturbance (+1) ◯ Every night (+0)

2. How much of your normal daily work does your shoulder allow you to perform?

◯ ◯ ◯ ◯ ◯ ◯ ◯ ◉ ◯ ◯ ◯

All — None

3. How much of your normal recreational activity does your shoulder allow you to perform?

◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯

All — None

4. To which level can you use your hand comfortably? (Please tick only the most advancement movement)

◯ Below the waist (+0) ◯ Up to the waist (+2) ◯ Up to the xiphoid / sternum (+4)

◯ Up to the neck (+6) ◯ Up to the tope of the hand (+8) ◯ Above the head (+10)

Scoring instructions	
A. Pain (max 15 points)	**Points**
Points are calculated by the equation: 15 – X = Score; X is the measured distance (cm) from "no pain" to the mark (use a ruler). If the value includes a decimal, round up or down to the closest integer:	
B. Activities of daily living (max 20 points)	**Points**
1. Sleep: Points are given in parenthesis:	
2. Normal daily living: The score is given by measuring the distance (cm) from "All" to the mark (use a ruler): 03cm = 4 points, >3-6cm = 3 points, >6-9cm = 2 points, >9-12cm = 1 point, >12-15cm = 0 points:	
3. Normal recreation activity: The score is given by measuring the distance (cm) from "All" to the mark (use a ruler): 0-3cm = 4 points, >3-6cm = 3 points, >6-9cm = 2 points, >9-12cm = 1 point, >12-15cm = 0 points:	
4. Hand comfort: Points are given in parenthesis:	
C. Movement (max 40 points)	**Points**
1. & 2. Forward and lateral elevation: Points are listed in the table:	
Flexion:	
Abduction:	
3. External rotation: Sum points from each separate completed movement:	
4. Internal rotation: Points are given in parenthesis.	
D. Strength (max 25 points)	**Points**
The score is calculated from the highest score of 3 attempts. The score in points corresponds to the force in pounds (max 25 points). If the strength is measured in kilograms, calculate scores by multiplying by 2.2.	
Constant Murley Score (max 100 points)	**Points**
Sum of points:	

C. Movement

Four different active and pain-free movements of the arm are performed. If the arm can be lifted to 140 degrees with pain and 110 degrees without pain in question 1,2, then a range of motion of 110 degrees is recorded. The tester first shows the desired movement, which the patient then performs. All exercises are done with the test subject standing with their feet pointing directly forwards and a shoulder width apart

1. & 2. Forward and lateral elevation are recorded with a long-armed goniometer. Only the affected arm performs movements. Please check one box:

Range of Motion (degrees)

Movement	**0 – 30**	**31 – 60**	**61 – 90**	**91 – 120**	**121 – 150**	**≥ 151**
Flexion	☐	☐	☐	☐	☐	☐
Abduction	☐	☐	☐	☐	☐	☐
Points	**0**	**2**	**4**	**6**	**8**	**10**

3. External rotation performed without help and the hands should be placed behind and above the head without touching the head. Movements are performed by both arms simultaneously but recorded only for the affected side. The movements must be performed painlessly. Please check all that apply.

☐ Hands behind head, elbows forward (+2)
☐ Hands behind head, elbows back (+2)
☐ Hand to the top of the head, elbows forward (+2)
☐ Hands to the top of the head, elbows back (+2)
☐ Full elevation of the arms (+2)

4. Internal rotation is performed without help and the subject should use their thumb to point to the specified anatomic landmarks. Movements are performed only with the affected arm. The movements must be performed painlessly. Please check only the box for the most advanced movement.

○ Lateral aspect of the thigh (+0)
○ Behind the buttock (+2)
○ Sacroiliac joint (+4)
○ Waist (+6)
○ 12th thoracic vertebra (+8)
○ Interscapular level (+10)

D. Strength

Strength is measured with a dynamometer. The test is done with the test subject standing with t heir feet pointing directly forwards and a shoulder width apart. The arm should be abducted 90 degrees in the scapular plane. If the arm cannot be elevated to 90 degrees, a score of 0 points is given. The wrist is pronated so the palm faces down and the elbow is stretched as much as possible. The strap of the dynamometer should be placed around the wrist of the test subject so that it lies over the long head of the ulna. The test subjected is instructed to push maximally upwards for 5 seconds and is given 3 attempts.

	1st attempt	**2nd attempt**	**3rd attempt**	**Best score**
Strength (lbs)				

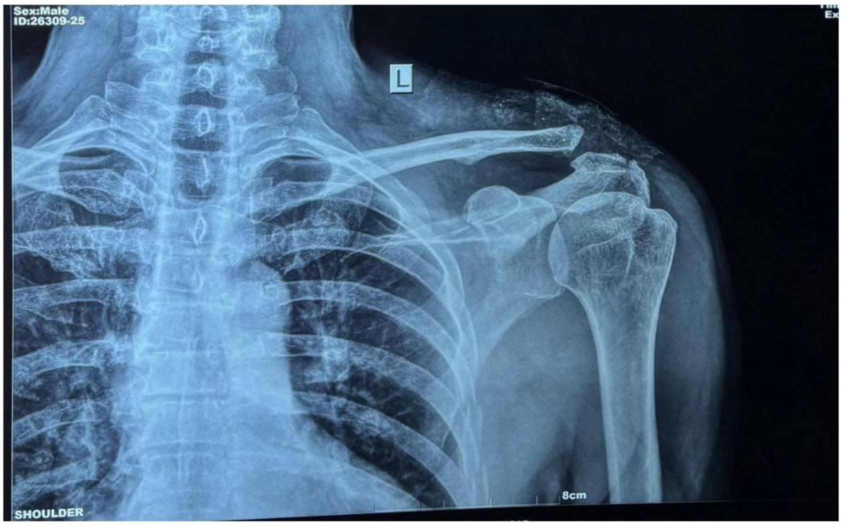
RESULTS

Immediate postoperative radiographs confirmed successful anatomical reduction of the AC joint across the entire patient cohort. However, over the course of the follow-up period, one patient experienced a subluxation, and another suffered a complete re-dislocation.

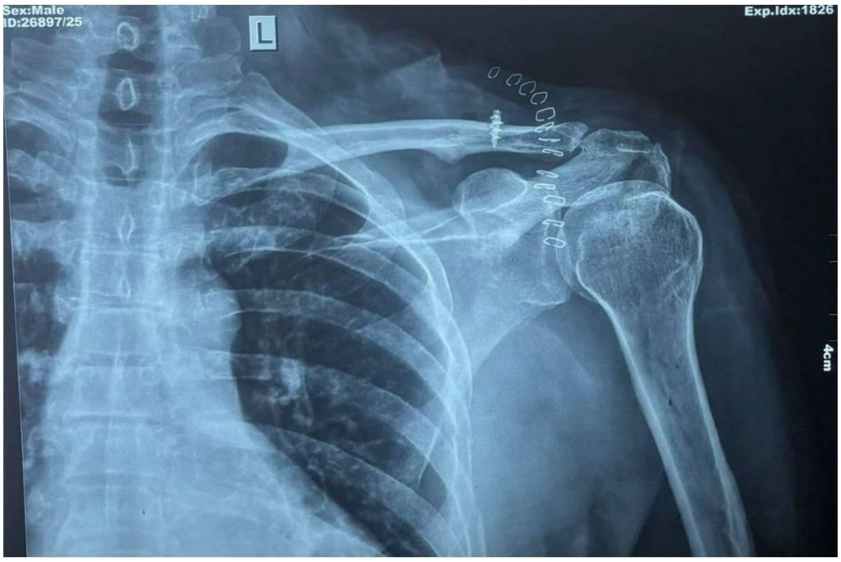
Patients were monitored for an average of 12 months (range: 9–23 months), and the mean time to return to work was 12.2 weeks (range: 8–18 weeks). Functional assessments revealed that 8 patients achieved a full, unrestricted range of shoulder motion, whereas 2 patients experienced some limitation in mobility. The overall mean Constant-Murley Shoulder Score was 93.2 (range: 59–100).

Regarding postoperative complications, two patients developed superficial wound infections, both of which fully resolved following an intensive regimen of antibiotics. Notably, there were no instances of neurovascular compromise or evidence of secondary degenerative changes within the AC joint.

PATIENT NO – 1 -

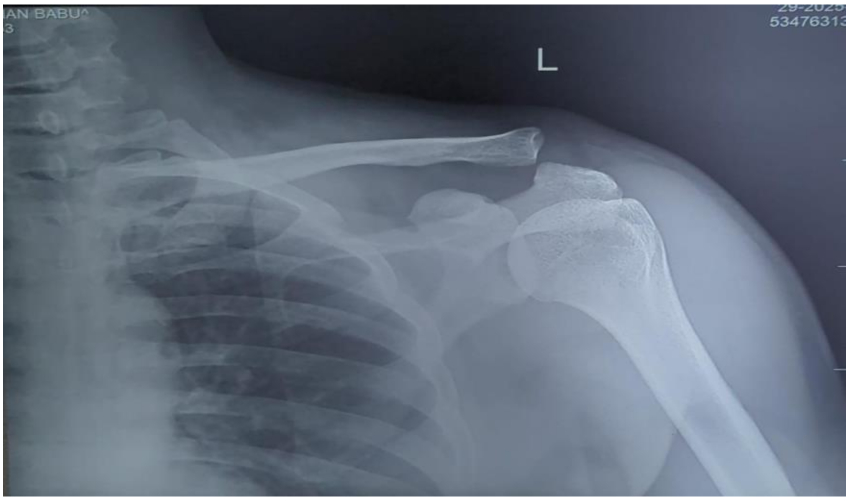


Pre-operative Radiograph of Acromio-clavicular Joint

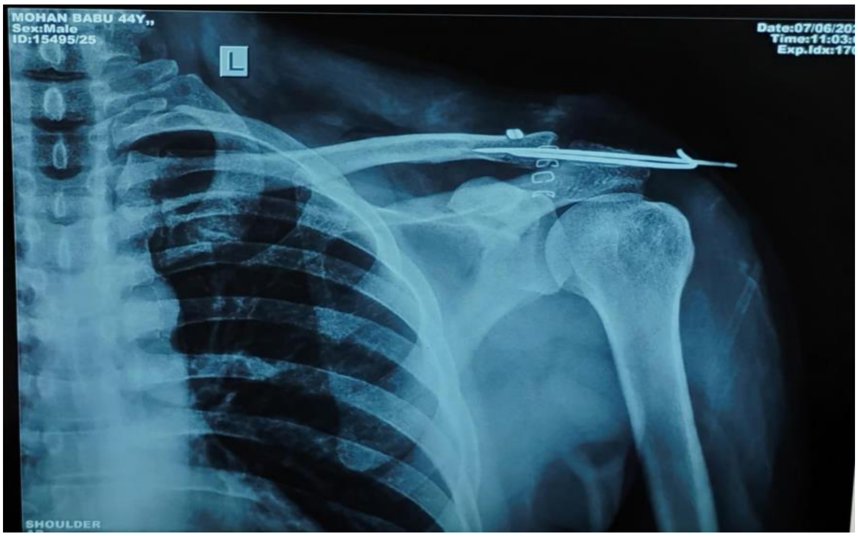


Post operative Radiograph Demonstrating Anatomical Reduction of Acromio-clavicular Joint

PATIENT NO – 2



PREOP X-RAY



POST OP X-RAY

DISCUSSION

Acromioclavicular (AC) joint disruptions are highly prevalent, particularly among the athletic population. Numerous surgical techniques have been detailed in the literature for AC joint reconstruction, which generally fall into three distinct categories: acromioclavicular fixation, coracoclavicular stabilization, and dynamic muscle transfers. Direct AC joint fixation has historically utilized various hardware, including smooth K-wires, tension band wiring constructs, threaded pins, and screws. However, these methods carry significant risks, such as accelerated AC joint arthrosis, hardware failure, and the potentially fatal migration of pins into the lungs, heart, or major intrathoracic vessels. Similarly, dynamic muscle transfer techniques—specifically those utilizing the short head of the biceps—demonstrate high overall complication rates and carry a specific risk of iatrogenic injury to the musculocutaneous nerve.

In contrast, coracoclavicular (CC) fixation techniques generally yield higher success rates with fewer adverse events. Securing the clavicle to the coracoid with synthetic cerclage bands provides adequate stability to maintain the AC joint reduction. These CC fixation constructs are broadly classified as either rigid (employing screws or metallic wires) or non-rigid (utilizing absorbable or non-absorbable sutures). While rigid constructs are prone to complications like screw pullout and breakage, traditional simple cerclage techniques are also flawed; they often result in anterior clavicular subluxation relative to the acromion, necessitate extensive surgical exposures, and remain technically challenging.

Addressing these biomechanical and technical challenges, a cadaveric study by Jericho *et al.,* (8) evaluated eight distinct AC reconstruction methods across ten shoulders. They concluded that utilizing a bone anchor system—specifically placing the anchor in the base of the coracoid and passing the fixation through a medialized drill hole in the clavicle—provided the most superior anatomic restoration. Consequently, the authors advocated for this anchor-based approach as the optimal technique for anatomic AC joint reconstruction.

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