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Coracoclavicular and acromioclavicular ligament reconstruction with a cost-effective and reproducible method: A new surgical technique

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Abstract
Background: Treatment of Acute Acromioclavicular joint injuries is controversial with varieties of treatment modalities. Newer treatment methods are expensive requiring additional cost and advance devices assistance. This technique demonstrates a very cost-effective (less than USD 25) method of fixing Acromioclavicular joint injuries suitable for developing nations.
Methods: From Year 2021 to 2023 we have performed 14 cases (aged 35-65 years) with good results with new surgical technique that utilizes 3- and 4-hole mini stainless-steel plates with no. 5 polyester suture, anatomic landmarks drilling based on study by Nai-Feng Zhu *et al*. (2015), and additional secure fixation at Acromioclavicular joint. Only 2 mm drill holes were used to avoid suture creep. No arthroscopy assisted device, titanium endo-buttons, tension-band, special hardware were used. All patients were counselled for strict post-op rehabilitation protocol for 3 months before full range of motion activities were allowed.
Result: This surgical technique provided secure fixation at coracoclavicular joints as well as acromioclavicular joints with 2 mm drill portals with minimum suture creep.
Conclusion: Our technique represents an anatomical, very cost-effective, and very reproducible way for treating acute AC joint separations especially focusing on developing countries.

Keywords: Acromioclavicular, suture fixation, cost-effective

Introduction
The management of Acromioclavicular joint injuries with completely torn coracoclavicular ligaments is often a surgical dilemma with varieties of treatment options ranging from suture fixation to advanced arthroscopic interventions with each promising a better outcome than the other.
All newer modalities require sophisticated instruments in the form of Arthroscopic aids, expensive implants and adjuncts. We present a simple, anatomical, cost-effective and reproducible technique especially suited for low income developing nations.

Materials and Methods
From year 2021 to 2023, we have performed 14 cases (aged 35-65 years) of Type V and Type VI AC joint dislocations with our new surgical technique with good results. The method requires just drill bit, stainless-steel plates, polyester sutures, k-wires which amounts to less than USD 20 as compared to thousands of dollars of arthroscopically assisted techniques and products. Here, we detail our technique.

Surgical Technique
1. Under adequate anesthesia, patient is positioned supine in beach-chair position. Properly painted and draped with upper arm freed from trunk drape. Surgeon stands at the head end with direct end on view.
2. A 5-7 cm curvilinear or bikini S shaped incision is made with curve end facing anterior around coracoid and ending at the AC joint (Figure 1a). Incision is deepened into the deltoid fascia and anterior border is easily lifted off the anterior border of clavicle thus opening the view of dislocated Acromioclavicular joint, torn Coracoclavicular ligaments and Coracoid area (Figure 1b).

3. A surgical ruler is used to designate the drilling points on the clavicle at 1 cm, 2 cm, and 4 cm from the lateral end of clavicle and a thickest girth of bone is selected for the Acromial drilling around 1cm from the medial end of acromion (Figure 2a). A 2 mm drill-bit is used.
4. 2 Antero-posterior direction drilling is done at 1cm from the lateral end of clavicle in clavicle (A) and another antero-posterior drilling is done at the acromion (D). A number 5 polyester suture is passed in figure of 8 fashion and loosely tightened with single knot (Figure 2b).
5. Medial 4 cm and 2 cm drilling is done in the clavicle in superior to inferior direction at point B and C. A no. 5 polyester is looped and passed through point C (Figure 3).
6. A right-angled forceps can be easily hooked underneath the coracoid which corresponds to around 1cm from the base of coracoid. Drilling is done at the middle of coracoid. The drill bit will hit the bend area of forceps in the middle. A looped Vicryl no. 1 suture is passed into the coracoid hole which is grasped by the right-angled forceps and passed through the drilled hole. The loop end is cut and two either end is checked for tail and head ends and secured with artery forceps (Figure 3).
7. The looped end of passed Vicryl is cut into two forming A-A' and B-B' threads. B' thread is tied onto the loop of polyester suture and pulled from B to pass through the hole (Figure 3).
8. The loop of polyester is now passed through the first and third holes of a 3 hole 2.7 mm mini plate (Figure 4a). The looped polyester is now tied with A end of the vicryl and pulled via the A' end of vicryl thus snuggly fitting the plate underneath of the coracoid. Before pulling through, adequate length of the polyester loop suture is to be adjusted to easy tightening later (Figure 4b).
9. Then the polyester loop is passed from inferior to superior drill hole of point B and now the whole loop comes to lie superiorly at point B (Figure 5a).
10. Two assistants are needed while securing the fixation. The Acromioclavicular joint can be used with gentle pressure over the 2nd and 3rd holes of a 4 hole 2.7 mm mini plate with periosteal elevator. The two assistants must tie the initial figure of 8 (points A and D) and the loop ends of polyester at the same time (Figure 5b). A single throw knot can be clamped of both the ends to see the adequate reduction first. If improper reduction or tension, knot should be untied and redone. Screws on either end are optional.
11. The soft tissues are closed in layers with thick deltoid fascia. Skin is closed with absorbable no. 3 monofilament suture.

Fig 1 a): 5-7 cm curvilinear incision is made over the clavicle. b) Anterior deltoid fibers can be lifted off the anterior border to access coracoid and acromioclavicular joint

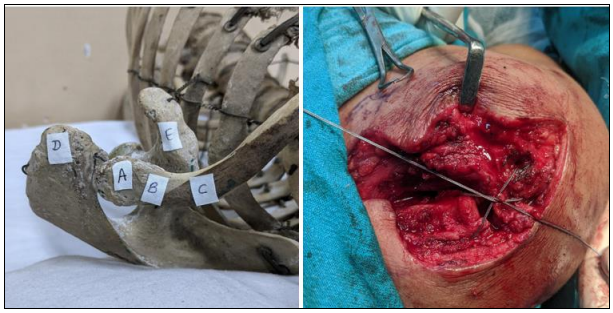

Fig 2 a): A, B, C are 1, 2, 4 cm medial from the lateral end of clavicle respectively. D is 1cm lateral to medial edge of acromian and E represents coracoid area. b) D and A are drilled anterior-posteriorly and no. 5 Polyester is passed and loosely tightened in figure of 8 fashion

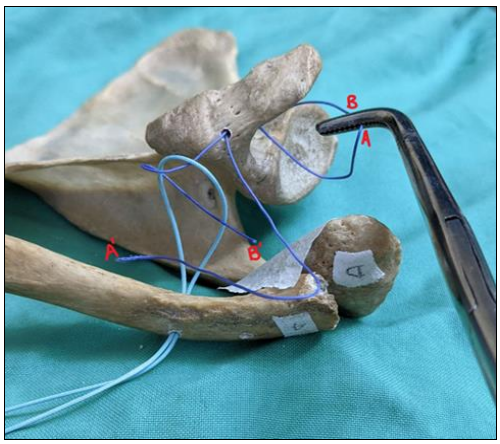

Fig 3: First hole to pass through is the medial most (C). A right-angled tip forceps is passed underneath the coracoid, drilling with 2mm drill bit is done aiming towards the forceps beneath the coracoid. A looped no. 1 vicryl is passed and grasped with the forceps. The looped end of vicryl is cut. B' end of vicryl is tied over the polyester suture loop and passed through the hole. A-A' suture is secured with artery forceps

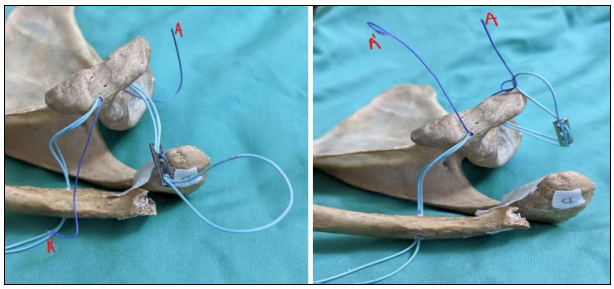

Fig 4 a): The looped polyester is passed through first and third holes of a 3 hole 2.7 mm mini plate. b) The looped polyester is now tied with A end of vicryl and pulled via the A' end of vicryl thus the plate sits firmly underneath the coracoid

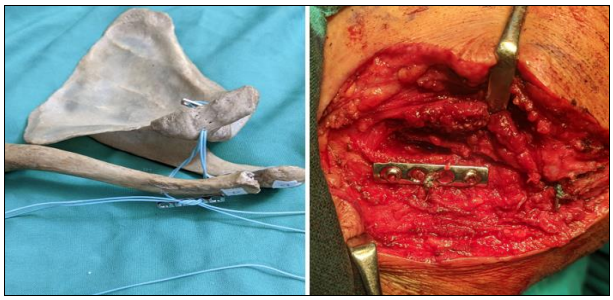

Fig 5 a): The looped polyester is passed through drilled hole B inferior to superior surface. B) The B and C point loop ends of polyester are tightened over 2nd and 3rd hole of a 4hole mini plate. The figure of 8 polyester at A and D are also tightened at the same time

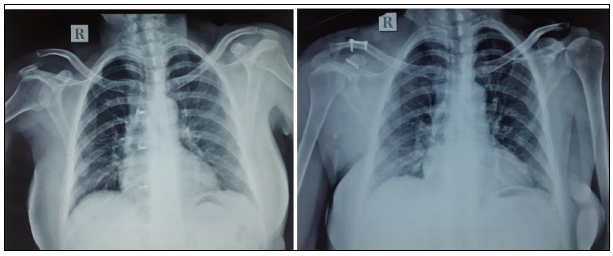

Fig 6 a): Pre-op type V AC joint dislocation in a 60 year female b) At 3 year follow-up

Post-Op protocol and Rehabilitation

Antibiotics are continued for 48 hours. Arm is rested in arm pouch sling and continued for a month. Forward flexion and extension exercises are begun at one month. Abduction is allowed from 0-30, 30-60 and 60-90 in one-two weeks increments from one months. Above head-abduction is not started until 3 months. Heavy activity is allowed from 6 months post-surgery.

Discussion

Nai-Feng Zhu *et al*. (2015) [1] on measurements of cadaveric specimens of 40 shoulders for anatomical coracoclavicular reconstruction found the trapezoid ligament to be at 21.7±1.1 mm and 6.4±0.5 mm from lateral end and anterior border of clavicle respectively; and the conoid ligament was 36.6±0.9 mm and 5.5±0.4 mm from the lateral end and posterior border of the clavicle respectively [1]. The landmarks in our technique follow these measurements. We have found the vector force while pulling doesn't coincide well with anatomic attachments at anterior or posterior border of clavicle likely because the suture material can't have multiple fanning attachments as ligaments. Thus, we have modified it to be more-or-less in the middle of anterior and posterior border.

Panagopoulos *et al*. (2021) [2] studied on the long-term stability of coracoclavicular suture fixation for acute acromioclavicular joint separation in 72 cases and found slight loss of reduction (12.5%), recurrence (1.7%), 1 fracture of lateral end clavicle and 2 cases with persistent tenderness [2]. The technique involved drill holes with 4.5mm size [2]. Our observations show the creep and loosening can be avoided with lower drill hole size, preferably 2mm, as the loop and fiber tape size are usually come in 2mm sizes.

Many studies emphasize coracoclavicular ligament reconstruction with different techniques with suture anchors, fixation device, hook plates, hamstring auto graft, allografts, non-absorbable suture materials show reliable technique for restoring stability and good to excellent clinical results. The parameters used were the American Shoulder and Elbow Surgeons (ASES) score, Constant Murley Score, Simple Shoulder Test (SST), Visual Analog Scale (VAS) [3].

Our study only demonstrates the newer surgical technique, further long-term prospective studies based on scores are to be carried out to demonstrate true efficacy at our setup.

Conclusion

Our technique represents an anatomical, very cost-effective and very reproducible way for treating acute AC joint separations especially focusing on developing countries.

Conflict of Interest

The authors declare that there is no conflict of interest in any form

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Not available

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