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Case report of non union of lateral end of clavicle fracture treated with modified weaver Dunn procedure and coracoclavicular screw fixation

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Abstract
A case of lateral end of clavicle non union in young patient, which was treated conservatively following trauma, treated with modified Weaver Dunn procedure, combined with fixation of coraco-clavicular interface with malleolar screw. Patient showed good range of movements at 6 months follow up.

Keywords: Lateral end clavicle non union, modified weaver dunn procedure, Bosworth screw fixation

Introduction
Non-united fractures of clavicle are occasionally seen in adults, but are rarely found in children. Post-traumatic non-union of the clavicle is a rare complication in adult with a frequency of about 1% in all lateral end clavicle fractures.
The distal 1/3rd of clavicle fracture is 15% of all clavicle fractures. Neer classified lateral end of clavicle fracture according to their location to coraco-clavicular ligaments [1].

Type description
1. Type I fractures are stable fractures located lateral to the coracoclavicular ligament complex.
2. Type II fractures are complex unstable fracture-dislocations which leave the distal end of the clavicle and the acromioclavicular (AC) joint untouched, separating the clavicle from the underlying coracoclavicular ligament complex through a vertical or oblique fracture line.
3. Type III fractures are intra-articular fractures into the AC joint causing late posttraumatic arthritis and pain.

Type II fractures are subclassified in type IIa and IIb fractures.
- In type IIa fractures, the fracture line is located medial to the coracoclavicular ligaments and both trapezoid and conoid ligaments remain connected to the distal fragment.
- In type IIb fractures, the fracture line is located between the coracoclavicular ligaments- the trapezoid ligament remains intact whereas the conoid ligament is ruptured.

The unstable type II fracture allows drooping of the upper limb with respect to the proximal clavicular fragment. The incidence of delayed and non-union is high in type 2 fractures.
Distal clavicular fractures are often associated with acromioclavicular and coracoclavicular ligament injuries. Most Acromioclavicular joint injuries can be successfully managed by nonoperative methods, [2, 3] such as use of anti-inflammatory drugs, ice packs, and protecting the arm in a sling for 2 to 4 weeks until the pain subsides. However, those who need to adopt an overhead position of the arm or in high-demanding work activities may prefer operative treatments. These can be classified into 4 types:
(1) Primary direct fixation of the ACJ (with screws, sutures, pins, hookplates, and even plates across the joint), with or without ligament reconstruction or repair [4].
(2) Primary CC fixation (with wire, screw, conjoint tendon or synthetic suture), with or without augmentation of AC ligament reconstruction, [5, 6].

(3) Excision of the distal end of the clavicle (as in the Mumford procedure), with or without CC ligament reconstruction; or repair with suture or coracoacromial ligament transfer (as in the Weaver-Dunn method), [4, 7] and
(4) Dynamic muscle transfer of the conjoint tendon, with or without excision of the distal end of the clavicle [8].

Weaver and Dunn first described the use of the coracoacromial ligament to reconstruct the coracoclavicular ligaments, The modified Weaver-Dunn method is one of the most popular methods. It involves excision of the distal end of the clavicle and transferring of the coraco-acromial ligament to the distal end of the clavicle, using the ligament as a substitute for the ruptured Coracoclavicular ligament. The coracoclavicular ligament is then augmented with Bosworths screw.

Case presentation

35 year old male, farmer by occupation, came to us with complaints of pain in left shoulder since 3 months, with history of road traffic accident 3 months back. Chief complaints were restricted activity and pain on movement, physical examination revealed deformity at lateral end of clavicle not in line with proximal fragment plain radiograph of shoulder with clavicle shows fracture of lateral end of clavicle in non-union. (figure-1). He was treated conservatively after trauma.

Fig 1: plain AP radiograpgh of left shoulder

Method

The patient was given a general anaesthetic and placed in beach-chair position. A longitudinal incision was employed to gain sufficient access to the ACJ and surrounding structures. The curved incision taken along anterosuperior margin of the acromion and lateral 1/4th of clavicle. [9]

The deltoid fibres are identified and peeled off in a subperiosteal fashion to expose the ACJ, the lateral end of the clavicle and the acromion. The tip of the coracoid, the coracoacromial ligament, and its insertion to the under surface of the acromion are identified. The acromial end of the coracoacromial ligament is isolated with its bony attachment using a reciprocating saw. (figure-2)

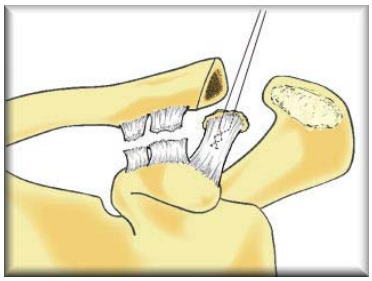

Fig 2: acromial end of the coracoacromial ligament is isolated with its bony attachment

The lateral end of clavicle in non-union is excised. Medullary canal of proximal clavicle is identified and curetted. Two or three unicortical drill holes are made in the upper cortex of the clavicle. The detached coracoclavicular ligament complex is sutured with nonabsorbable suture (ethibond) through these drill holes in clavicle, but sutures not tightened fully, and clavicle is manipulated to sit in normal anatomical position.(figure-3, 4)

Fig 3: unicortical drill holes are made in the upper cortex of the clavicle.

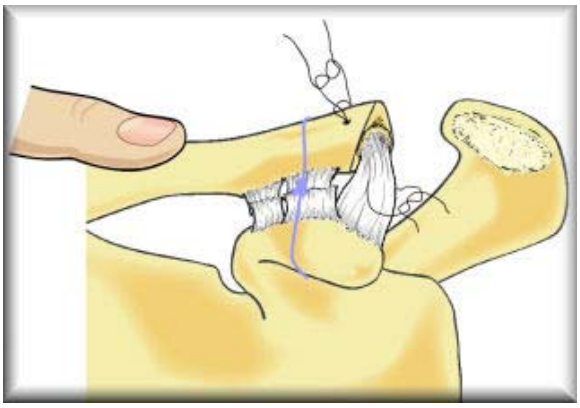

Fig 4: detached coracoclavicular ligament complex is sutured with nonabsorbable suture (ethibond) through these drill holes in clavicle

The clavicle was exposed subperiosteally at the level of the coracoid and the base of the coracoid was exposed between two small retractors. A 3.5 mm hole was drilled through the clavicle at the predetermined position. An AO malleolar screw 40 mm with washer was placed through the drill hole, and screwed into the base of the coracoid process. (figure-5) after this coracoclavicular ligament sutures tightened fully.

The fascia between deltoid and trapezius was meticulously repaired; the wound was closed.

Postoperatively sling is given is continued till 6 weeks following surgery. Passive shoulder exercises allowed on day one such as forward flexion, extension. With gradually progressing abduction movements. Pre-operative patient having painfull abduction of 40-50 degree. Post-operative 4 months follow up shows abduction of 90 to 110 degree with no pain. (figure-6)

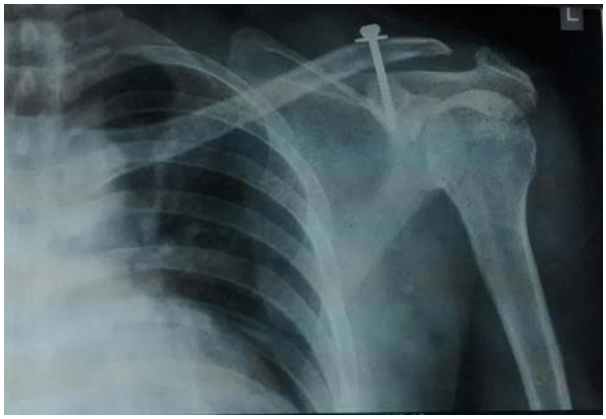

Fig 5: Post op radiograph

Postoperative 4 months Bosworth screw was removed under local anaesthesia. (figure-7)

Fig 6: showing 90 degree of abduction of left upper limb, post op-4 month

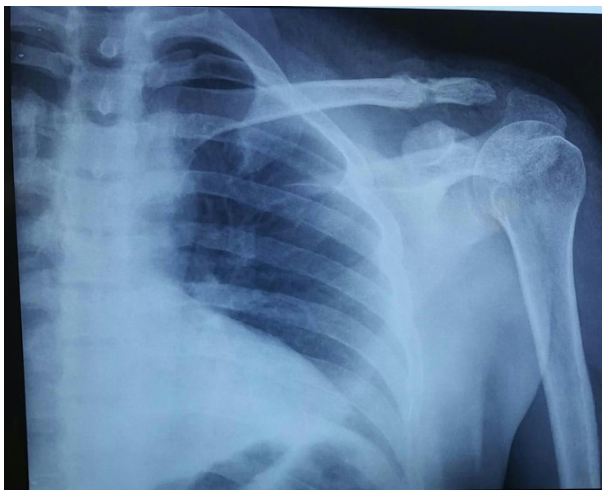

Fig 7: post op 4 months radiograph after removal of malleolar screw.

Patient is able to do assisted or with support, painless abduction upto 160-170 degree. (Figure - 8) And coraco-clavicular distance of right (7.1mm) and left side (7.8mm) (figure-9).

Fig 8: post operative 6 month clinical picture showing 160 degree of abduction

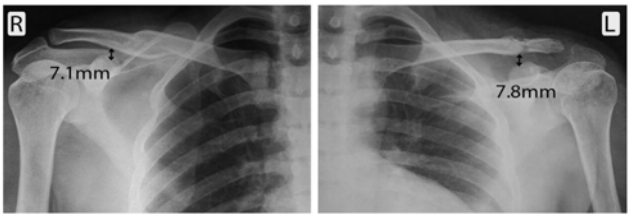

Fig 9: radiograph comparing coracoclavicular distance of right and left side. Right (7.1) left (7. 8)

Discussion

As several studies show good results with modified weaver Dunn procedure, there are chances of persistent subluxation or dislocation of acromioclavicular jointafter treatment [10, 11, 1]. Even with secure fixation, bone ligament interface will require longer time to heal than that of bone to bone because of relative avascularity of ligaments [12]. Also anteroposterior stability is poor. Transfer of the coraco-acromial ligament may be associated with the risk of ongoing pain, instability, and recurrent subluxation because of stretching or failure of fixation of the re-attached Coraco-clavicular ligament [13]. The Weaver-Dunn procedure has only 30% of the strength and 10% of the stiffness of the intact ligaments, and failures occur mainly at the suture that attaches the transferred coraco-acromial ligament [14]. Therefore augmentation of this fixation, by fixation of clavicle with coracoid, to support the ligaments and helps in rapid healing. But with this fixation there is risk of fracture or osteolysis of coracoid can occur.

The knowledge of the blood supply of the clavicle may help understand the occurrence of nonunion and osteolysis. Knudsen *et al*. found that the suprascapular, the thoracoacromial, and the internal thoracic arteries provided blood to the clavicle [15]. The authors reported that the main blood supply was primarily periosteal and that no nutrient artery was found. Therefore, any injury to the periosteal vascularity during the surgical procedure may cause clavicle osteolysis or nonunion [15, 16]. Considering that important branches reach the posteroinferior part of the clavicle, care must be taken to not perform a wide deperiostization of the lower rim of clavicle. In fact, the thoracoacromial artery was found to constantly supply the lateral 4/5 of the clavicle

through its clavicular and acromial branches, with an inferoanterior relation to the bone approximately 2 cm medial to the distal end [15]. One step of the modified Weaver-Dunn's technique is the oblique resection of 2 cm of the distal clavicle. This step may explain the development of osteolysis or nonunion.

Excision of the lateral end of clavicle which was in non union, and transferring coracoacromial ligament to clavicle by bone-bone interface, fixation of coracoid to clavicle with malleolar screw gives a good method for treatment, with early return of function. With this technique a stable reduction in all planes is achieved allowing early mobilization of the shoulder joint.

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