



Orthopedics

A PROSPECTIVE STUDY OF FIXATION OF FRACTURE LATERAL END CLAVICLE BY A NOVEL TECHNIQUE & ITS EARLY RESULTS

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ABSTRACT

BACKGROUND: Fracture Lateral end clavicle can be managed by various treatment modalities, with different pros & cons. Our study is a prospective study, showing a novel technique & its early results. We found initial results to be very encouraging.

MATERIAL & METHODS: We had utilized this novel fixation technique on 16 patients & operative indication in all patients was Neer type 2 lateral end clavicle fractures.

In this study, 14 patients were male while 2 were female in age group 25 to 58 years (mean 41 years). All the patients were operated within 2 weeks of sustaining trauma to clavicle. Early results were encouraging in these patients with minimum follow up of 4 months & maximum of 12 months.

Constant murley scores measured & compared were found to be approaching at the opposite shoulder levels at the end of 6 months after surgery.

RESULTS: All 16 patients were available for evolution after minimum follow up of 4 months and maximum of 12 months.

All the patients regained pain less shoulder with bony union & returned to pre-injury activity level after a mean of 4 months. During post operative follow up after 2 weeks, 2 months & 4 month post-operative radiographs demonstrated good hold of initial bony reduction

CONCLUSION: The concept of this technique is novel and provides for a strong fixation across the fracture site in addition to other benefits outlined above. Further studies with longer follow up and more number of patients need to be done to elucidate out correct surgical utility of technique over others.

KEYWORDS : Fracture lateral end clavicle, neers type 2 fracture

INTRODUCTION

Lateral end clavicle fractures are common injuries of shoulder girdle, making approximately 15% of all clavicle fractures.^[1] Integrity of lateral end clavicle and its ligamentous attachments is essential for functioning of shoulder girdle. Fractures of lateral end clavicle disrupt this vital integrity and are source to various complications associated with this fracture.

Clinical implications of fracture pattern of lateral end clavicle were first pointed out by Neer. Neer segregated these fractures in three subtypes based on osseo-ligamentous injury pattern, treatment rationale and outcome of injury. Type I injury is fracture lateral to intact coracoclavicular ligaments with typically minimal displacement. Type II injuries occurred more medial to the coracoclavicular ligaments with significant displacements across fracture site. Type III injuries extend intraarticularly in acromioclavicular joint.^[2]

Neer type 2 injuries assume special concern because of inherent unstable nature. Disruption of ligamentous tether, deforming forces by trapezius on proximal fragment and downward pull by pectoral muscles, latissimus dorsi along with weight of arm on distal fragment essentially impede fracture apposition and is root to problem of nonunion.^[3,4]

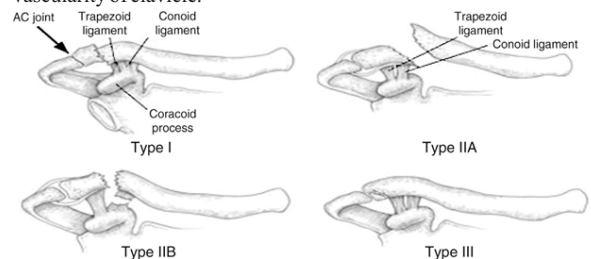
Neer estimated higher risk of nonunion type 2 injuries of distal clavicle compared with other clavicle fracture types with rates reported as high as 22% to 50% for non-operatively managed fractures. Nonunion of fracture lateral end clavicle has been corroborated with poor functional outcome and symptomatic shoulder in recent literature with evidence favorably siding toward surgical management of this variety of fractures.^[2,5]

Surgical and nonoperative management have both been advocated by numerous authors. Surgical modalities are broadly either transacromial fixation or stabilization of the medial fragment with either a coracoclavicular screw or coracoclavicular slings. Transacromial fixation technique can be done either using Kirschner wires, cerclage wiring of the fragments, tension band wiring, plate fixation, osteosynthesis using a hook plate.

Despite all these, optimal treatment modality remains a topic of debate.

Transacromial fixation using wire or pin construct offer poor fracture stabilization thus delaying early mobilization, higher rate of infection, nonunion, arthritis, risk of pin migration. Coracoclavicular screw yields rigid fixation of coracoclavicular space, which causes frequent backing of screw on shoulder mobilization or fracture of screw or coracoid process in noncompliant patients. Plate fixation gives in risk of iatrogenic damage to rotator cuff and acromioclavicular joint, revascularization of clavicle, hardware prominence, problems related to hook of plate. Coracoclavicular slings or sutures has been also associated with redisplacement or suture loosening.^[4,6,7]

All these techniques strive to reestablish integrity of suspensory mechanism of shoulder either by direct fixation or indirect reduction so that sequent bony consolidation reassumes its function. Based on these principles, we employed a new technique of reduction of type 2 distal clavicle fractures and its maintenance by spanning coracoclavicular space with ethibond no 5/fiber tape no 2 suture secured over two endobuttons along with possible repair of damaged ligaments. Construct is augmented with temporary K-wire spanning fracture fragments but sparing acromio-clavicular joint for a short period. Technique is simple, cause minimal damage to soft tissues, allows for indirect reduction. Other purported benefits are physiological non-rigid fixation, least hardware prominence and least effect on vascularity of clavicle.

**SURGICAL TECHNIQUE**

Patient is operated under general anesthesia and in supine position with a small bolster placed under ipsilateral shoulder. An incision is made from palpable coracoid to medial clavicle fragment near fracture site. Medial and lateral skin flaps are created. Supraclavicular nerve twig, if

met in incision need protection and retraction on medial side. Deltopectoral fascia is opened transversally along the directions of its fibers and muscle beneath it. Anterior fibers of deltoid met need to be lifted subperiosteally from antero-superior clavicle to facilitate visualization of coracoid with due protection of coraco acromial ligament. Subperiosteal lifting preserves retrograde neural supply of deltoid. This small muscle flap is secured with suture for later reattachment. Integrity of coracoclavicular ligament is inspected, and care taken not to inflict any iatrogenic damage to it. Medial and lateral borders of coracoid are identified.

Location of acromioclavicular joint is confirmed as a landmark for further work. A drill hole using 4.5 mm drill bit is made in centre of coracoid at junction where it turn laterally with care not to tether surrounding tissues or overshoot drill. Fracture reduction is achieved indirectly manipulating upper limb and a Kirschner wire is passed spanning two fracture fragments. Now another drill hole is made using 2.5 mm drill bit around 40 mm from acromioclavicular joint on superior surface of clavicle in middle portion. This 40 mm distance falls on medial clavicle fragment and makes fixation amenable using this technique. A fracture fragment larger than 40 mm is amenable to fixation using standard contoured plate.

An Ethibond #5 or fibrewire #5 is spanned across second and third hole of endobutton and using an endobutton plunger, it is passed through coracoid hole and flipped on its undersurface. Now two suture end are passed from underneath of clavicle to its superior surface using a suture shuttle and secured with knot over an endobutton again after final confirmation of fracture reduction. This now locks endobutton using snow shoe effect on cortical bone and secures fractures strong enough to allow further bone healing. Deltoid is reattached to clavicle surface and wound is closed in layers. K wire holding reduction is cut beneath the skin.

Postoperatively, limb is kept/comforted in universal shoulder immobilizer for 3 weeks with intermittent pendulum exercises and abduction exercises. After 3 week, when fractures is expected in stage of preliminary callous/ sticky, K wire is extracted under local anesthesia. Gradual range of motion exercises are started with limb being comforted in arm pouch sling. Heavy work and contact sports is prohibited till solid bony union is confirmed on radiographs.

RESULTS



The authors has utilized this fixation technique on 16 patients. Operative indication in all patients was Neer type 2 distal clavicle fracture. 14 patients were male while 2 were female in age group of 25 to 58 years (mean 41 years). The dominant limb was involved in 10 out of 16 cases. None of the patient had concomitant injury to ipsilateral upper limb. All the patients were operated within 2 weeks of sustaining trauma to clavicle. Early results were encouraging in these patients with minimum follow up of 4 months and maximum of 12 months.

All the patients regained painless shoulder with bony union and return to pre-injury activity level after a mean of 4 months. 2 weeks, 2 months and 4 months postoperative radiographs demonstrated good hold of initial bony reduction. Constant Murley scores measured and compared was found to be approaching opposite shoulder level at the end of 6 months after surgery.

DISCUSSION

Basic principle of surgery is to reestablish the integrity of shoulder suspensory mechanism by providing/reaffirming bony continuity and a healed coraco-clavicular ligament. Numerous techniques have been employed to fulfill these principles with differing clinical results, and mix of merits and demerits over each other.

Flinkilla^[8] and Klein^[9] both separately found fracture union rate after clavicular hook plate approaching 95%, but with significant complication rate in around 22%. Frequent peri-implant fracture medial to plate(5%), persistent pain by acromial abrasions obligating second surgical procedure for implant extraction in almost all cases make it a less preferential modality. Rigid construct of clavicular hook plate translates into increased deforming forces at plate ends and thereby causing subacromial abrasions and stress fractures at ends. Superior locking plates use is also waning due to frequent implant failure and poor biomechanical construct.

Various pin and wire constructs have been used but have fallen out of favor as preferential modality. Bisbinas^[4] Lyons and Rockwood^[10] found troubles like poor stabilization, lack of early mobilization, high infection and nonunion rates(23%), acromioclavicular arthritis(10%), bizarre pin migrations even in thorax, aorta, subclavian artery and spinal canal.

Sambandam^[11] reviewed literature about lateral end clavicular fractures and found that although coracoclavicular screw is simple and cost effective, it need prolonged immobilization of shoulder risking joint mobility, mandatory avoidance of arm abduction and forward flexion beyond 90degree. Obligatory need of implant extraction and risk of coracoid fracture, which make it rarely done in clinical practice. As evidenced in recent literature, coracoclavicular space spanning slings, sutures, tapes are gaining momentum as preferred modality for fixation of Neer type II clavicular fractures owing to nonrigid near biological fixation, obviated need for implant extraction, least mechanical problems, minimal tissue invasion, and feasible use of endoscope using modes of fixation. Few constant problems have been cited with these methods are loosening of sutures, slip of sling over clavicle surface, biomechanically weaker construct.^[4,7,11]

Cognizing all these aspects of techniques, we employed a novel method of fixation for type 2 clavicular fractures. Whole idea was to keep tissue dissection minimal, use of material with ample strength, secure fixation of suture over clavicle surface, temporary assistance for fracture apposition till soft callus by K wire, providing milieu for natural coracoclavicular ligament healing and sparing acromioclavicular joint.

Fibrewire secured with endobuttons provide enough stability across fracture to facilitate bony union. Tensile strength of fibrewire is highly comparable to native coracoclavicular ligaments, with 2 strands spanned across space providing theoretically more strength.^[12] Endobutton also have pullout strength in excess of 1150N. Endobuttons provide snow shoe effect for firm hold on bone.^[13] Smaller hole in clavicle lessens chances of fracture line propagation and comminution. Being a low profile implant, need for future extraction of implant is also obviated. Early extraction of K wire is easy, almost noninvasive and out patient procedure.

Any injury to coracoclavicular ligament is also dealt by accompanying stable fixation. In acute settings, healing response to ligament injury is robust and other than respecting soft tissues in vicinity and providing stable fixation, additional grafting is not necessary.^[14] Prudent

contraindications for the use of this technique include: coracoid fractures, lack of soft tissue coverage, a narrow coracoid and ongoing infections.

The concept of this technique is novel and provides for a strong fixation across the fracture site in addition to other benefits outlined above. Further studies with longer follow up on and more number of patients need to be done to elucidate out correct surgical utility of technique over others.

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