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Open double endobutton loop fixation, a one-stop solution for both; Lateral end clavicle fractures and acromioclavicular joint dislocations

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Abstract
Introduction: Fracture lateral end of clavicle and Acromioclavicular (AC) joint disruption have been managed by various direct and indirect surgical methods. The restoration of the coracoclavicular interspace is of utmost importance to maintain the stability around the acromioclavicular joint and to prevent recurrence of the deformity. This retrospective study compared the results of fixation of fracture lateral end clavicle and AC joint dislocation using double endobutton loop fixation.
Methods: This study is conducted at a tertiary care trauma center in December 2020. The clinical and radiological data of all patients with Neer type II lateral clavicle fractures and Rockwood type V AC joint dislocations (both fresh injuries and neglected) who had undergone fixation using double endobutton technique between January 2016 to December 2020 were reviewed. CONSTANT score and UCLA shoulder rating scale for functional outcome with at least 1 year of follow up were evaluated and compared.
Results: Ten patients with Neer type II fracture lateral end clavicle and eight patients with Rockwood grade V AC joint disruption were included in this study. The average age of patients in the study was 39.89 ± 9.95 years with 14 male and 4 female patients. The average duration from time of injury to surgery was 5.44 ± 1.2 days and the average duration of surgery was 55.33 ± 7.24 mins. The mean CONSTANT shoulder score was 88 ± 6.56 and the UCLA shoulder rating scale was 31.06 ± 2.1 for the study group.
Conclusion: Open double endobutton loop system is a suitable fixation method for fracture lateral end clavicle (Neer type II) and also for AC joint disruption (grade V) with satisfactory functional outcome. It also avoids the hardware related problems which are commonly encountered in rigid fixation systems warranting implant removal after sometime. More prospective studies are required for evaluation of outcomes of this technique.

Keywords: lateral end clavicle fractures, AC joint dislocation, double endobutton loop fixation, coraco-clavicular ligament, CONSTANT score, UCLA score

Introduction

The fractures of the lateral end of clavicle and Acromioclavicular joint (AC joint) disruption often resemble each other. Their mode of injury is similar, clinical presentation of both often resemble each other, deformity presents in the same way and the restrictions of the movements are similar. The coracoclavicular ligaments are often injured in both the injuries. The objective of treatment is to restore its function and decrease vertical and horizontal instability [1-3]. However, a simple anteroposterior radiograph with a stress view of the shoulder with clavicle is often enough to differentiate the two.

Fixation of lateral end clavicle fractures have been a little tricky. Many static and dynamic techniques have been described, each having its advantages, disadvantages, and complications. Despite this, there is still no established gold standard of treatment. Many different implants like rigid plates with hooks, TENS nails and Tension band wiring have been used with limited success. There have been repeated complaints of implant prominence and subsequent implant removal surgeries. Then came the Suspensary devices such as Double endobutton loop fixation, with its advantage of being less invasive and almost inconspicuous.

AC joint dislocation injuries present with the similar features and almost similar challenges in the treatment. Different ways of managing such injuries are described in literature. Weaver- Dunn procedure disrupts the coracoacromial arc and Hook plates lead to coracoid osteolysis. Bosworths screw fixation technique requires screw removal in all cases. The suspensory devices again showed their superiority with or without CC ligament reconstruction as they are less invasive and less hardware problems.

The aim of this retrospective case series is to compare the radiological & functional outcomes of Rockwood type V AC joint disruptions and Neer type II lateral end clavicle fixations using the same technique.

Methods

This retrospective case study is conducted at a tertiary care trauma center in December 2020 after obtaining clearance from the institutional review board. The clinical and radiological data of all patients with Neer type II lateral clavicle fractures and Rockwood type V AC joint dislocations (both fresh and neglected) who had undergone fixation using double endobutton technique between January 2016 to December 2020 were reviewed. Patients with any other systemic injury and patients with associated injuries of the ipsilateral upper limb were excluded from the study. Consent for using patient individual data for participation in the study was taken at the time of admission. All the cases were operated upon with open reduction and internal fixation using a double endobutton and fiber wire loop system under general anesthesia.

The surgical technique is a modification of the double endobutton technique described by Struhl [4]. The patient was positioned in supine position with a bolster underneath the interscapular area and a vertical incision centered over the coracoid and extending upwards to the clavicle was made. After the requisite dissection, coracoid was exposed. A vertical tunnel was made in the coracoid in a cephalocaudal direction with a 4.5 mm hollow reamer over a guide wire. Endobutton with fiberwire loop was passed through this tunnel and manually flipped to hook the endobutton beneath the coracoid. Delto-trapezial fascia was dissected from the clavicle so that the lateral portion of the clavicle was exposed. Another tunnel was drilled in the clavicle in line with the coracoid tunnel and midway in the anteroposterior borders of the clavicle. Another endobutton from the same fiberwire loop was passed through the clavicular tunnel in an upward direction and flipped to rest over the superior surface of the clavicle. Reduction of the fracture fragments or acromioclavicular joint was achieved by manual reduction and tightening of the fiberwire loop. The achieved reduction was secured after tying the knot of the fiberwire over the clavicular endobutton.

In 4 cases of chronic acromio-clavicular joint dislocations, additional reconstruction of the coracoclavicular ligament was done using a hamstring graft in a “U” fashion around the coracoid and clavicle fixation was done by tying a knot of the graft over the clavicle (Figure 1). This technique was somewhat similar to the Mazzocca technique (25) described for anatomic reconstruction of coracoclavicular ligament. All the patients were given arm pouch sling till the suture removal at 2 weeks. Gradual shoulder exercise program was initiated with gentle abduction, forward flexion, extension and rotation exercises after suture removal as per the pain tolerance of the patient.

The primary outcome of this study was to evaluate the Constant shoulder score and UCLA shoulder rating scale after 1 year postoperative. The data was entered into SPSS v25, mean and standard deviation were calculated.

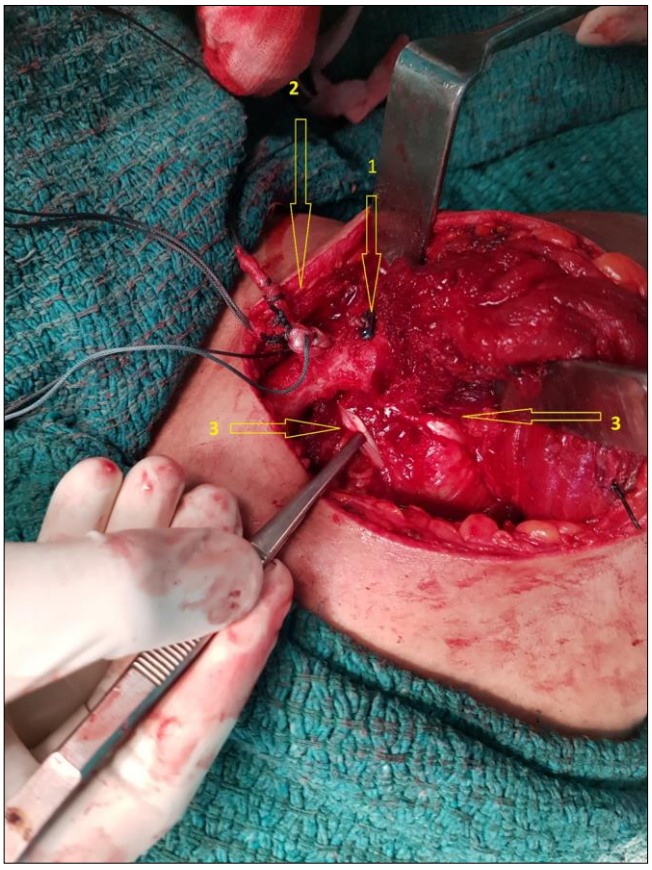

Fig 1: Intraoperative picture of Dual endobutton fixation showing only the clavicular button (Fig: 1.1) along with newly reconstructed Coracoclavicular ligament (Fig:1.3) and the knot (Fig:1.2) over the superior surface of clavicle.

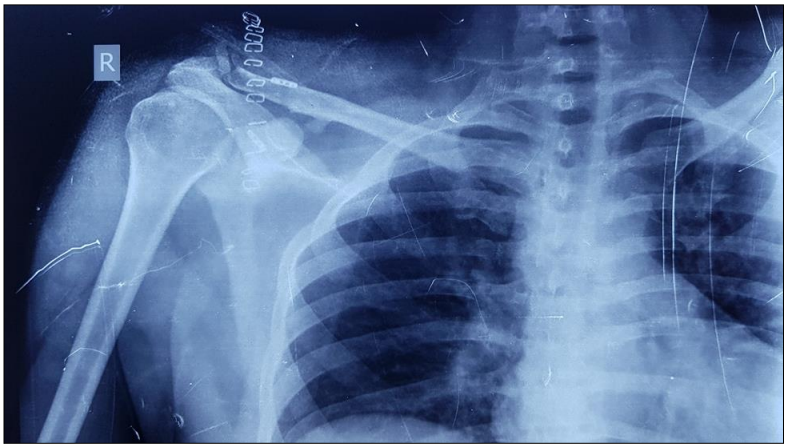

Fig 2: Immediate post-op radiograph of the patient shown in Fig:1.

Fig 3: Pre-operative clinical pictures of a patient with chronic AC joint dislocation in Fig 3(A,B,C). Post-operative clinical pictures and radiograph of the same patient in Fig 3(D,E,F).

Fig 4: Pre-operative radiograph of a patient with Lateral end Clavicle fracture (Fig: 4.A). One year post-operative radiograph of the same patient showing a completely united fracture(Fig:4.B). Fig:4.C,D,E; showing clinical results at 1 year follow-up.

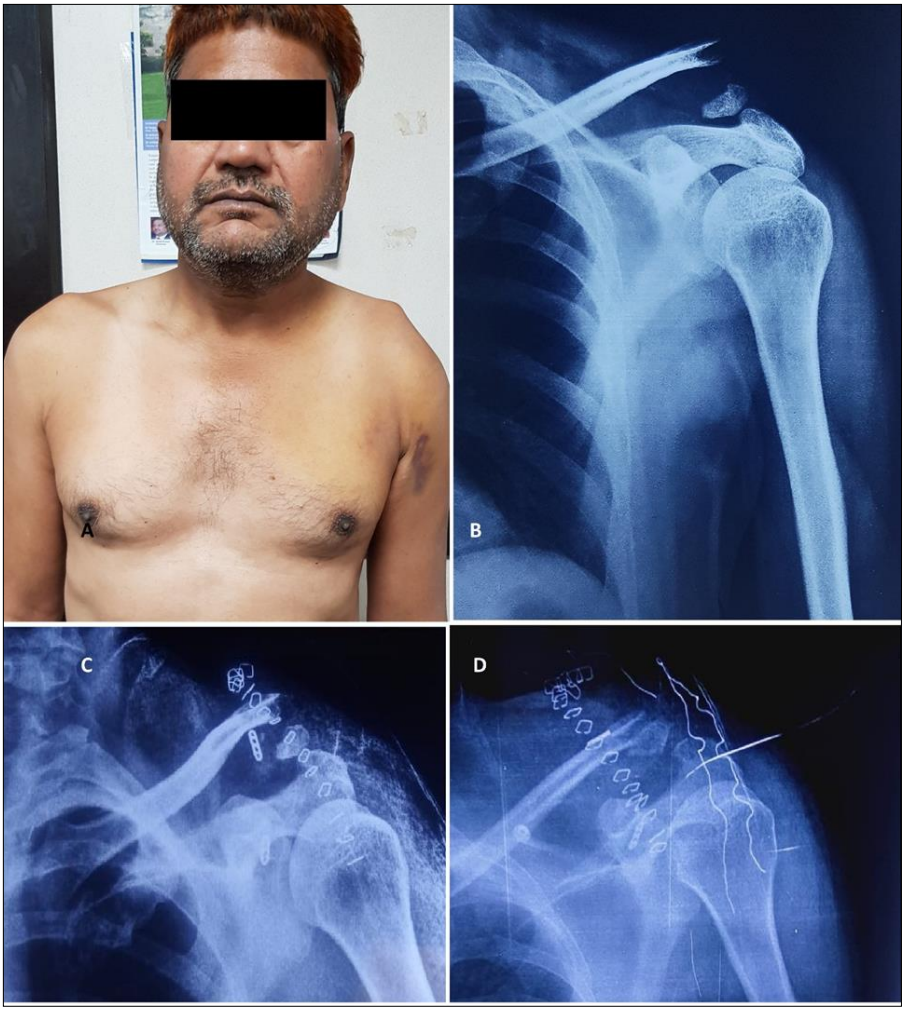

Fig 5: A patient of lateral end clavicle fracture. Fig: 5.A: Pre-op clinical presentation of the patient. Fig.5.B: Pre-op radiograph of the same patient. Fig.5.C: Immediate post-op radiograph showing dislodgement of superior endobutton. Fig.5. D: Post-op radiograph with replacement of the endobutton immediately.

Results

A total of 24 patients with AC joint and lateral end clavicle were identified based on the hospital records. Six patients were excluded as they were lost to follow-up and a total of 18 patients were included in the study. Ten patients had been operated for fracture lateral end of clavicle and 8 patients for AC joint disruption. Out of which 4 were fresh injuries and 4 were neglected injuries. For neglected injuries, additional reconstruction of the coraco-clavicular ligament was done using hamstring graft. The mean follow up of 2.5 years (1 to 4 years) for the patients.

The average age of the patients was 39.89 ± 9.95 years with 14 male and 4 female patients. All 8 patients of AC joint disruption were Rockwood type V injuries. The average duration from time of injury to surgery was 5.44 ± 1.2 days and the average duration of surgery was 55.33 ± 7. 24mins.The average duration of surgery was found to be 55.33 ± 7.2 minutes.

The mean CONSTANT shoulder score was 88 ± 6.56 and the UCLA shoulder rating scale was 31.06 ± 2.1 for all patients. When assessed separately, the mean CONSTANT score was 85.9 ± 6.9 and the UCLA score was 30.30 ± 2.26 for lateral end clavicle fractures. The CONSTANT score for AC joint dislocation was 90.62 ± 5.36 and UCLA score 32 ± 1.51.

There was loss of reduction in the immediate post-operative period in one patient, where the endobutton from the clavicular side was found to be displaced in the post-operative radiograph. (Figure 4) Most likely because the endobutton was not placed centrally over the clavicular tunnel and it got displaced. This was managed by re-inserting the same endobutton from the same tunnel from inferior upwards, the next day. The fracture united normally and the patient reported a good functional outcome at the end of 1 year. One patients developed a superficial skin infection in the post-operative period which was managed by oral antibiotics. No other complications were noted for the study group.

Discussion

The principle of treatment for both AC joint and lateral end clavicle injuries is to restore the function of the coraco-clavicular ligament to prevent instability. [1-3] A wide variety of fixation methods have been described in the literature for the management of both the injuries [5, 6].

Most clavicle fractures are managed conservatively, however if the fracture is distal to the coronoid tubercle an operative course of treatment may be considered based on the stability of the Coraco-clavicular ligament [7]. The lateral clavicle fracture fragment is usually too small to hold any rigid implant like screws. The treatment options can be divided into direct osteosynthesis using distal clavicle plates or indirect reduction using only Coraco-clavicular ligament reconstruction where a Neer type II is converted to a stable Type I pattern. The primary disadvantage of using direct fixation is the relative high rate of complications like more intraoperative blood loss, decreased shoulder range of motion, implant loosening, periprosthetic fractures, rotator cuff tears, acromion erosion, painful subacromial impingement requiring plate removal as soon as union occurs.[8-10] To overcome these complications many indirect methods using sutures, endobutton, autografts, allografts and synthetic materials to reconstruct the CC ligament have been described [8-12].

The mean CONSTANT score at the end of this series was 85.9 ± 6.9 for lateral end clavicle fractures. This score was similar to scores reported by Kuener *et al*. (81.8 ± 8) and Kraus *et al* (89%) who also used arthroscopic endobutton for fixation of lateral clavicle fractures and concluded that it was a suitable method for fixation for such fractures with good functional outcome [13, 14]. They found that some risk factors may increase chance of delayed union or non-union [13]. Zhang *et al* reported a score of 92.33 ± 4.89 which was slightly better than previous series using double endobutton but with open technique. (11) Sautet *et al* reported mean weighted CONSTANT scores of 91% (85-95%) with 28% (n=4) reporting clavicular button irritation and 2 requesting removal [11]. but in our series, none of the patients had similar complaints. Loriaut *et al*, Flinkkillä *et al* and Motta *et al*, all reported higher CONSTANT scores. [15-17]. The mean UCLA score in this series was 30.30 ± 2.26 in lateral clavicle fractures, this is similar a study by Struhl *et al*. (32.5 ± 3.7) [18].

The fixation of the AC joint is also challenging due to the muscle forces acting on the region and the instability caused by the loss of the CC ligament. Many techniques have been described by authors using single bundle, double bundle and sling reconstructions using autograft, allograft and synthetic materials. Due to similarity in the biomechanics of the injury to lateral clavicle fractures the CONSTANT and UCLA scores are often used to assess functional outcomes. The CONSTANT score for AC joint dislocation in this study was 90.62 ± 5.36 this is similar to studies by Struhl *et al*; Sharma *et al*, Zhaoxun *et al* and Taleb *et al* who reported CONSTANT scores of 98, 91.17 & 93.1 ± 2.4 & 91.7±5.9 respectively [18-21].

The UCLA score for the series was 32 ± 1.51 for AC joint dislocations. This was also similar to Struhl *et al*, Taleb *et al* and Unal *et al* who recorded a score of 33.7 & 32.2±1.4, 30.2 (3.67) for continuous double endobutton group [4, 21-23].

Manohara and Reid compared the radiological outcomes and QuickDASH scores of AC joint injuries and lateral end clavicle fracture using a percutaneous endobutton fixation and concluded that the method was comparable to other techniques [24]. On performing a paired t test of CONSTANT and UCLA scores at the end of the study of the two types of injuries we found no statistically significant difference between the scores indicating no difference in functional outcomes, we did not find any studies comparing open technique for the two injuries.

The main limitations of this study were a small sample size and a relatively short duration of follow up. The absence of an arthroscopic/ percutaneous group for comparison for results is also a drawback for the study.

Conclusion

An open double endobutton loop fixation is an acceptable method of treating Neer type II lateral end clavicle fractures and Rockwood type V AC joint dislocation with no difference in functional outcomes for fresh and neglected injuries. However more studies, larger sample size and comparison groups are required for more conclusive results.

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