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Management of rockwood type III acute acromioclavicular joint dislocation using closed loop double endobutton technique

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Abstract
Background: Type III Acromioclavicular joint injuries poses a management quandary to the orthopaedic surgeons owing to lack of consensus regarding its management. A multitude of fixation techniques have been devised, used and rejected as per clinical and experimental studies. In this study, we aim to evaluate the efficacy of closed loop double endobutton technique in the management of acute Rockwood Type III AC joint injuries.
Materials and Methods : A total of 17 patients were included in our study operated using double endobutton and polyester no. 5 suture. Subjective shoulder value and Constant-Murley score was used to evaluate the functional outcome. Follow up was done till a minimum of 1 year.
Results: The Constant -Murley score at final follow up was 95.4 and the subjective shoulder value was 93.2 %. No major complications were seen in our study.
Conclusion: The results of our study suggest that the closed loop double endobutton technique is an excellent surgical modality in the setting of acute type III AC joint dislocation and is associated with minimal complications.

Keywords: type III AC joint dislocation, acute AC joint injuries, rockwood classification, double endobutton, constant- Murley score

1. Introduction
The acromioclavicular joint injuries inspite of its high prevalence of 12% of all shoulder injuries pose a treatment dilemma to the Orthopaedic surgeons owing to the lack of accord regarding its diagnosis and treatment [1]. The Acromioclavicular joint injuries account for 3-4 % of all body dislocations and around 50% of all injuries occur during sporting activities with a preponderance in male population [2]. The AC joint injuries were first classified by Tossy [3] into types I, II, III. Rockwood *et al*. [4] expanded the classification system to include type IV, V and VI. Expectant management is preferred for type I and II whereas operative treatment is opted for type IV, V and VI by most surgeons. Rockwood type III injuries remain the centre of controversy as numerous biomechanical studies have lead to development of many surgical techniques that have their own sets of advantages and disadvantages [5]. The main aim of surgical procedure in acute setting is to achieve healing of ligament whereas in chronic cases the main aim of undertaking an operative procedure is to reconstruct the torn ligament with incorporation of a graft [5, 6]. A plethora of surgical options like Bosworth screw, k wire, TBW, Steinman pin, hook plate, suture/tape sling, suture button device, musculo fascial and tendon graft substitutes have been used in the management of type III AC joint injuries [6, 7]. The ideal treatment option, best implant choice is still however a matter of debate.
This prospective study was undertaken to determine the efficacy of closed loop double endobutton technique in the setting of acute type III AC joint injuries.

2. Materials and Methods
2.1. Patients
The study was conducted in the Department of Orthopaedics, Gauhati medical college &

hospital, Guwahati during 2019(april-october) after taking institutional ethical clearance. A total of 17 patients (13 male,4 female) with AC joint type III injuries were included in the study after obtaining informed and written consents. Patients below the age of 18 years, patients with chronic dislocations, degenerative disease of the same shoulder were excluded from the study. Patients were diagnosed with anteroposterior radiographs and clinical examinations. Follow up was done for a period of 1 year (Table 1).

Table 1: Patients characteristics included in the study

Number of patients(n)	17
Male, female	13(76.5%), 4(23.5%)
Mean age (years)	29.4± 4.2(21-41)
Interval to surgery (days)	5.2 ± 3.8(3-7)
Dominant side involvement	12(70.5%)
Extremity involved	Right – 11(64.7%) Left – 6(35.3%)
Mode of injury	RTA – 7(41.2%) Self-fall- 4(23.5%) Sports injury- 6(35.3%)

2.2 Surgical technique[5](figure 1)

All the patients were operated in beach chair position after induction of general anesthesia with padding of all the bony prominences. A small towel bump was placed beneath the medial border of scapula to prevent protraction of scapula. A 2-2.5cm horizontal incision was made over lateral end of clavicle, 2-2.5cm medial to AC joint. After splitting the delto-trapezoidal fascia, a vertical incision of 2.5 cm was made from the tip of coracoid. Soft tissue over the tip of coracoid and inferior surface was released. The PCL zig was placed at base of coracoid and clavicle taking care not to disrupt the soft tissue further. A beath pin was drilled and resistance felt over clavicle and then coracoid. 4.5mm sized drilling was done over Beath pin after checking and conformation with the help of C -arm. Then a Beath pin with Polyester No.5 in its eye was driven through clavicle to coracoid in reverse direction. Thereafter, double endobutton and polyester no. 5 suture assembly was pulled through the pulling Polyester No.5. AC joint was reduced manually by applying digital pressure and once the confirmation of reduction was achieved, the endobutton was tightened. Closure was done in layers followed by sterile aseptic dressing.

Fig 1: Intraoperative C-ARM image

2.3 Follow up

All the patients were followed up for a minimum of 1 year. Follow up was done at 2 weeks, 6 weeks, 3 months, 6 months and 1 year. Sutures were removed after 2 weeks and a sling was used for 6 weeks post-operatively. Pendulum exercises were advised from 3 weeks to 6 weeks. From 6weeks to 10 weeks ; forward flexion, abduction ,internal and external rotation along with shoulder shrugging exercises were advised. Full activity was resumed at 6 months.

2.4 Outcome assessment

Clinical results were assessed with use of the subjective shoulder value [8]. In this score, a normal shoulder is assigned a value of 100 % and a patient subjectively assigns a comparatively value to the affected shoulder as a percentage of normal. Assessment also included the Constant -Murley score[9] alongwith VAS for pain measurement. Goniometer was used to assess the active shoulder motion.

3. Results

A total of 17 patients were included in our study; amongst which 13 were male (76.5%) and 4 were female (23.5%). The mean age of the population was 29.4± 4.2(21-41) years and the mean interval from trauma to surgery was 5.2 ± 3.8(3-7) days. The dominant side was involved in 12 out of 17 cases (70.5%). RTA and sport injuries were the most common mode of injury as 13 out of the 17 cases were a result of either RTA or sports injury.

The mean shoulder value improved from 25.4% to 93.2% postoperatively and the relative Constant -Murley score was 35% preoperatively and 95% postoperatively at the end of 1 year of follow up.

No cases of deep surgical infection, suture failure, knot slippage, perioperative fracture were seen in our study. Two cases of superficial infection were seen that subsided with oral antibiotics. The results are summarized in table 2.

Table 2: Outcome assessment in the Preoperative and Postoperative period

Criteria	Pre-operative	Post-operative follow up (1 year)	p-value
Subjective shoulder value (%)	25.4	93.2	<0.001
Constant-Murley score (%)	35.2	95.4	<0.001

Fig 2: Preoperative radiograph of a 26 year old patient

Fig 3: Radiograph at 1 year follow up



Fig 4 **Fig 5** **Fig 6**

Fig 4-6: Range of motion at 3 months follow up

4. Discussion

AC joint capsule, coracoacromial ligament, conoid and trapezoid ligaments are the main constituents of the AC joints that allow it to transfer weight from the axial to the appendicular skeleton [10]. The primary load bearing structure is the conoid while the trapezoid is an important secondary load bearing structure as per Fukada *et al*. [10]. Controversy mars the treatment approach to AC joint type III injuries. Some guidelines prefer operative treatment for young active, sports person, manual laborer and person engaged in overhead activities [11-12]. No prospective randomized control trial exists on whether to manage type III AC joint injuries conservatively or surgically. American orthopaedic surgeons prefer conservative management in oppose to Germany which favour surgical treatment as the first choice [13-14].

The various surgical treatment modalities for an AC joint dislocation can be grouped into five categories viz AC joint fixation using k wire, hook plate, TBW; CC joint fixation using screws, suture sling, suture anchors, tape, button device etc ; CC ligament reconstruction; Dynamic muscle transfer and excision of lateral end of clavicle [15]. In the year 1921, Bosworth introduced screw fixation between coracoid and clavicle; a technique complicated by implant failure, loosening, mal positioning, osteolysis, second surgery for removal and fracture of coracoid and clavicle [16]. Weaver-Dunn [17] in the year 1972 devised a technique involving transfer of CA ligament and resection of distal end clavicle; however high failure rates were reported with this technique [18]. The crux of management in the acute stage of injury is to provide sufficient rest to the joint so as to facilitate the ligament healing [19]. Various materials have been used to maintain AC joint reduction in the past while allowing spontaneous healing to take place. Successful result from the past techniques (pinning, screws, hook plate) strongly indicate this healing capacity [5].

In the double end button loop technique, physiologic loads are borne by two surfaces of end button and not the suture itself so there are less chances of suture failure [5]. The results of our study are consistent with some of the other authors evaluating the efficacy of double end button technique in the management of acute type III AC joint injuries. Struhl *et al.* [19] reported a Constant – Murley score of 98 in 31 patients using closed loop endobutton device. Sharma *et al* documented a Constant- Murley score of 91.17 using mini invasive double endobutton in patients with acute AC joint dislocation grade III and V [20]. Likewise, Zhang *et al* received excellent results using modified closed loop double endobutton technique over clavicle hook plate fixation and conventional double endobutton technique in patients with grade III AC joint injuries [21]. We obtained outstanding functional scores in our study without any major intraoperative or postoperative complications owing to our meticulous surgical technique and rigorous post-operative rehabilitation protocol. All the patients were operated within a week of injury which influenced the favourable outcome as early surgery is documented to provide better outcome, low infection and escapes from more invasive approach, graft related morbidity and removal of distal end clavicle [18, 19, 22].

There were a number of limitations in our study. The sample size was small and the follow up period was not long enough. We did not compare the double endobutton technique with other procedures.

5. Conclusion

Based on the findings of our study, we would like to conclude that the closed loop double endobutton technique is a highly efficacious treatment modality for the management of acute type III AC joint dislocations with high functional outcomes and minimal complications if performed using a scrupulous surgical technique.

6. Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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