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Original Research Article

Management of lateral end clavicle fractures-using either pre-countered lateral clavicle locking plate or clavicular hook plate: A prospective study

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Abstract

Background: Fractures of the clavicle are common injuries of adults, accounting for about 3% of all injuries. Lateral end clavicle are unstable due to the various deforming forces which act on the fragments as well as the small distal fracture fragment. Unfortunately, there is no reference standard treatment recommendation for this fracture. In this study, we assessed two fixation technique using the pre-contoured locking plates and clavicular hook plates to find out stability of fixation and functional outcome.

Methods: Totally, 30 patients with lateral end clavicle fracture (Neer's Type II) were included in the study. After the informed consent and preoperative investigations, open reduction and internal fixation (ORIF) was done in 16 patients using a 3.5 mm pre-contoured locking plates (Group A) and 14 patients with clavicular hook plates (Group B) under general anaesthesia. Postoperative X-rays were done on immediate postoperative day and subsequently at 4 weeks, 8 weeks, 12 weeks and 6 months where serial monitoring was done regarding placement of plate, implant loosening, osteolysis, cut out of plate and fracture union. The functional outcome was assessed using Constant-Murley score at each follow up.

Results: There were no intraoperative complications noted in procedure of fixation in either of the Groups. In pre-countered locking plate group mean duration to union was 13.33±2.126 weeks and the mean Constant-Murley score was 92.16 whereas in patient operated with clavicular hook plate, the mean duration to union was 15.33±2.134 weeks and the mean Constant-Murley score was 88.36.

Conclusions: The pre-contoured locking plates and clavicular hook plates are good method to fix the fractures of the lateral end clavicle. They provide a stable fixation with good functional outcome with very few instances of stiffness and decreased range of motion when compared to other mode of fixation for lateral end clavicle fractures.

Introduction

Clavicle fracture accounts for 2-5% of all injuries in adults and 10-15% in children. Midshaft being the most common site (80%) the lateral end clavicular fracture constitutes for 15% of all clavicle fracture [1, 2].

It always creates a clinical dilemma for the treating surgeon for managing lateral end of the clavicle fracture [3, 4]. The unstable nature of these fractures makes them prone for non-union and impeding the normal shoulder function. One of the most commonly used classification of

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lateral third clavicle fracture is Neer's classification.

Major factors which leads to displacement of these fracture patterns are the weight of affected side upper limb and pull of the latissimus dorsi, pectoralis muscles and scapular rotations pull the distal fragments downward and the trapezius pulls the proximal fragment superiorly.

Unfortunately, there is no reference standard treatment recommendation for this fracture [4]. Conservative treatment of severely displaced clavicle fractures has been observed with poor outcomes like malunion and non-union (22%-50%) and shows good outcome up to 95%-98% in minimally displaced or Undisplaced fractures.

It is difficult to get an anatomical reduction due to various deforming forces which also poses problems in its fixation resulting in instability of the lateral clavicle fractures as the fractured fragment is small [5]. Flexible or rigid surgical fixation helps to avoid the deforming forces acting on these fragments and help in maintaining reduction.

Surgical options described in literature are K-wire fixation [6], lateral end of the clavicle excision, screw stabilisation from the clavicle to the coracoid process, coracoclavicular screws [7, 8, 9], tension bands, CC screws [10], hook plates [11, 12], nonlocked plate and superiorly placed locking plates [13].

In this study, we assessed the functional and radiological outcomes of the patients treated with either pre-contoured locking plates [14, 15] or with Hook plate for fixation of the lateral end of clavicle fractures (Neer's Type II lateral clavicle fractures) [6].

The indication for surgical treatment of lateral-third clavicle fractures is based on the stability of the fracture segments, displacement and patient age [5]. The non-union risk increases with advancing age and displacement [9, 5, 16]. The presence of soft-tissue compromise, multiple traumas and floating shoulder are also indications for operative treatment.

Recent development of a pre-contoured locking plates and screws [14], for fixing fractures of the lateral end of the clavicle are fixed angle constructs which have greater resistance to screw pull out and helps to maintain stable construct across the fracture segment [24].

Materials and Methods

It is a prospective study conducted in the Orthopaedics department of Karnataka institute of medical science (KIMS), Hubli for a period of 3 years (April 2019 to March 2022). A total of 30 patients reporting to the Orthopaedics OPD and casualty with fractures of the lateral end of the clavicle were considered for the study. Complete details were taken regarding mode of injury, age, limb affected. patients operated with pre-countered locking plate were included in Group A and those operated with clavicular Hook plates were included in Group B.

Patients

All patients were more than 18 years, and no minors were included in this study. Patients presenting with an acute fracture of lateral end clavicle (Neer's Type II) were considered for the study.

Fractures more than 7 days old, with neurovascular deficits, severe brain injury, intubated patients, those with open fractures and those with injury preventing operative fixation within 7 days of admission were excluded from our study.

Patients were included in this study after explaining the procedure in their own language and necessary consent was obtained after the patients showed their willingness to participate in the study.

A detailed history was elicited regarding mechanism of injury and enquiry was made to note site of pain and its nature. Decision to operate was made based on surgeon's assessment and patient's consent. Plain x-ray of clavicle with both shoulder in anteroposterior view was taken to assess the site of fracture and the fracture type.

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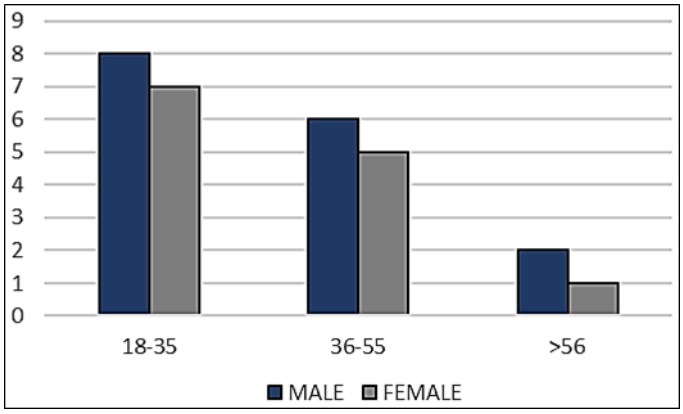

Age and sex distribution of lateral end clavicle fractures during the study period presenting to KIMS, Hubli

Preoperative procedure

Oral and parenteral NSAIDs were used in most cases to relieve pain after their admission and arm sling was given to prevent further displacement, to reduce spasm and pain. Patient was advised to perform active finger movements.

Fractures were classified according to Neer's classification [6]. Pre-anaesthetic evaluation was done for all cases. Preparation of parts and scrubbing done prior to surgery. Prophylactic parenteral 2nd generation cephalosporin was administered one hour prior to surgery and postoperatively.

Surgery

Surgery was planned and the patient underwent surgery as soon as possible after initial assessment and workup for operative intervention. In all the patients selected for our study, open reduction and internal fixation (ORIF) was done using either a 3.5 mm pre-contoured locking plate (Fig-1) or with clavicular Hook plates (Fig-2).

All the surgeries were performed under general anaesthesia either in a beach chair position with the affected arm in a mobile position or in supine position with roll of towel between scapula to retract clavicle. Head being turned to opposite side for better view in both position. Centring over the fracture site, horizontal incision was taken over superior clavicle. Subcutaneous tissue and platysma is separated to expose the fracture site and fracture was fixed with either of the plates. The closure was done in layers.

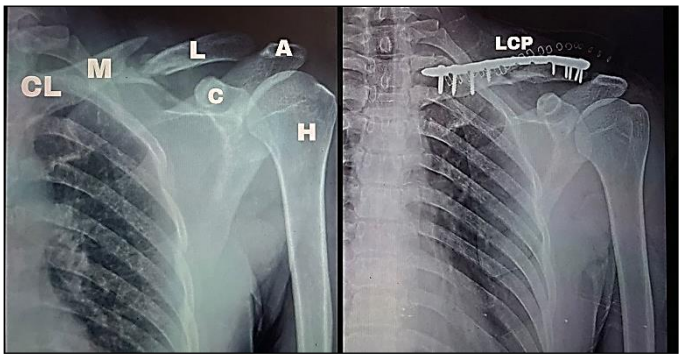

Fig 1: Pre-op and immediate post op x-rays following ORIF with pre-countered locking plate and screws.CL-Clavicle, L-Lateral fracture segment, M- medial fracture segment, C-Corocoid process, A-Acromion, LCP-pre-countered lateral locking compression plate, H- Humerus, A-Acromion

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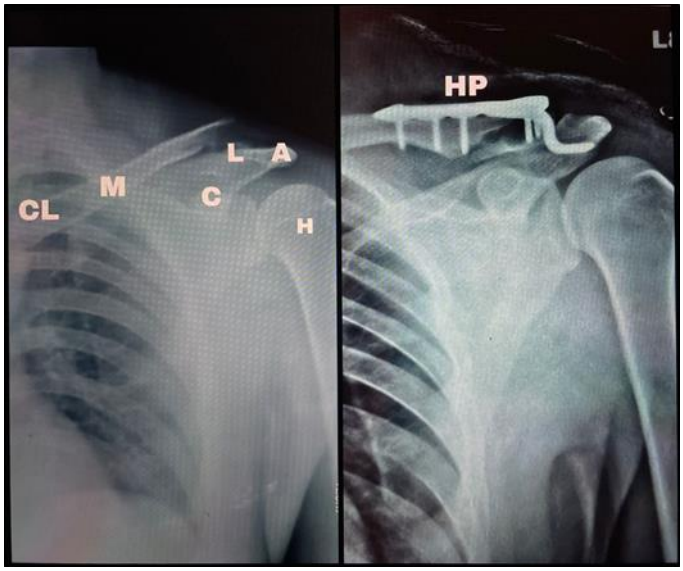

Fig 2: Pre-op and immediate post op x-rays following ORIF with clavicle Hook plate and screws. CL-Clavicle, L-Lateral fracture segment, M-medial fracture segment, C-Coracoid process, A-Acromion, HP-Clavicular Hook plates, H-Humerus, A-Acromion

Postoperative protocol

In both the groups, Post-surgery the arm were immobilized in an arm pouch and Antibiotic coverage was given for 5 days. Sutures were removed on 12th day post-operatively.

Patients started physiotherapy on the first postoperative day following a standard rehabilitation protocol: active and passive range of movement was encouraged within the pain free arc. Active range of shoulder motion with abduction limited to 80 degrees was started 4 to 6 weeks post-operatively.

X-rays were taken preoperative, immediate postoperative and subsequently at 4 weeks, 8 weeks, 12 weeks and 6 months where serial monitoring was done regarding placement of plate, implant loosening, osteolysis, cut out of plate and fracture union.

Follow up

Post-operatively, all the patients were followed up at 4, 8, 12 weeks and 6 months. Functional assessment was done using Constant-Murley [8, 23] score at each follow up.

Results

30 patients with unilateral lateral end clavicle fracture were included in the study. The average age of patients was 25.6 years, ranging from 18 to 28 years. Approximately two thirds of the patients were male with non-dominant side being affected (56.69%). 16 cases were operated in Group A (pre-contoured locking compression plate) and 14 cases were operated in Group B (clavicular hook plate) [Table-2].

Road traffic accident being the most common mechanism of injury (70.53%) followed by self-fall (26.33%).

The time from trauma to surgery ranged from 0-7 days with a mean of 4 days in both group. The mean operating time was 46 minutes ranging between 25-70 minutes with Mean duration to union was 13.33±2.126 weeks and the mean Constant-Murley score was 92.16 in locking pre-countered plate group. Whereas in patient operated with hook plate mean operating time was 51 minutes ranging between 30-72 minutes with Mean duration to union was 15.33±2.134 weeks and the mean Constant-Murley score was 88.36.

In Group A, 87% had union time of 8 weeks or less. Based on the Constant-Murley score, 25% of the patients in the operative group had an excellent outcome, 50% had a good and 19% had satisfactory functional outcome. whereas in Group B, 78% had union time of 8 weeks or less with 14% showing excellent outcome, 43% satisfactory outcome and 29% showing

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satisfactory outcome. One case (6%) from Group A and two cases (14%) from Group B has poor functional outcome. The functional outcome was significantly better in the operative Group A than in Group B during the period of follow up. (Table-2).

No Superficial infection and one implant failure (in the form of screw loosening) was noted in both group and there was one incidence of Malunion in Group B.

Table 1

Characteristics	Group A(n=16)		Group B(n=14)	
	Number(n)	Percentage (%)	Number(n)	Percentage (%)
Age (in years)				
18-35	8	50.00	7	50.00
36-55	6	37.50	5	35.71
>56	2	12.50	1	07.14
Gender				
Male	12	75.00	11	78.57
female	4	25.00	3	21.42
Side of fracture				
Right	7	43.75	6	42.85
left	9	56.25	8	57.14
Mode of injury				
RTA	10	62.50	11	78.57
Self-fall	5	31.25	3	21.42
others	1	06.25	1	07.14
Union time				
≤ 8 weeks	14	87.50	11	78.57
> 8 weeks	2	12.50	3	21.42
Functional outcome at 6 months				
excellent	4	25.00	2	14.28
Good	8	50.00	6	42.85
Fair	3	18.75	4	28.57
poor	1	06.25	2	14.28
Complications				
Infection	0	0	0	0
Implant failure	1	06.25	1	07.14
Non-union	0	0	0	0
malunion	0	0	1	07.14

Discussion

Clavicular injuries are very common with incidence of about 29 to 64 per 100,000 population per year [3, 17, 15]. Nonoperative management shows good outcome up to 98% in minimally displaced or undisplaced fractures while rates increase with fracture displaced and patients age [5].

Operative management is preferred for most displaced fractures as the rate of non-union is higher following non-operative treatment of unstable lateral clavicle fractures and the literature ranges from 11% to 40% in small case series [19]. However other associated injuries like rib fracture, scapula injury, humerus fracture, Radius and/or ulna fracture of ipsilateral side also affects the functional outcome of that affected upper limb.

There are numerous options available for the operative management. Special pre-contoured locking plates [14, 15], clavicular hook plates [11, 12] were two of most commonly used fixation tools for unstable lateral clavicular fracture where both showed good functional outcome and union rate when compared to other modes of fixation.

AO hook plate result in rotator cuff injury, shoulder stiffness, and acromioclavicular joint osteoarthritis which has been reported by Henkel *et al.* [18]. It is such that it has no rotational stiffness but allow normal rotation at the AC joint allowing undisturbed bone healing.

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Removing these plates earlier than 6 months can result in non-union or refracture, while late removal can cause shoulder stiffness [19].

Fleming *et al*. reviewed 19 patients who underwent surgery with superior pre-countered locking plates for displaced distal third clavicle fractures. All patients achieved union by 4 months and no plates have been removed.

Sambandam *et al*. [20] commented that hook plates result in major complications despite giving good functional outcome. Distal clavicle fracture can also be fixed with Distal radius plate. Fixation with K wires and applying a tension band is an age old technique for these fracture.

Kalamaras *et al*. [21] described use of a low profile volar distal radius locking plate, in which all patients achieved union with a mean Constant-Murley score of 96 and this reported major complication in 10% of the patients.

In our present study, there was 100% union and excellent to good outcome (By Constant-Murley score) in 75% in Group A and 57% in Group B. Qureshi *et al*. [22] for locking plates, which showed a union rate of 97.7% and Constant-Murley score excellent to good outcome in 73% patients.

Conclusion

Due to its unstable nature [5, 25], Distal clavicular fracture can present as a clinical dilemma for the treating surgeon. Risk factors for non-union in these fracture would help us to make decision between operative and nonoperative treatment. As such there is no "gold standard" fixation method for unstable distal clavicle fractures, satisfactory outcomes could be obtained using the lateral clavicle locking plate or hook plates resulting in sufficient stabilization and good functional outcome.

Pre-countered Lateral clavicle locking plate fixation is an absolute indication for the communized lateral clavicle fracture [26] to facilitates early mobilization of the shoulder postoperatively and to achieve high percentage of union with a good objective and subjective shoulder function whereas in fracture involving small lateral end clavicle fragment clavicular hook plates [11] is preferred for better hold and early mobilization.

Although, the incidence of implant failure was evident in both the, the proportion was lesser in Group A (6%), compared to Group B (7%) which was not clinically significant. whereas the functional outcome was comparatively better in pre-contoured locking compression plate than in clavicular hook plate.

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