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Functional outcome of medial end clavicle fractures treated with ipsilateral lateral locking clavicular plate– A prospective study

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Abstract

Background: This study involves evaluating functional and outcome in Medial end clavicle fracture treated with ipsilateral Lateral locking clavicular plates, twisted through 90 degrees around its axis, would decrease intraoperative complications.

Materials and methods: 9 patients of Medial end clavicle fracture treated with Lateral end clavicular plates at MMC, Mysore from august2020 to May 2022 with age from 28 years to 62 years. In the operation, a curved incision approximately 8 to 10 cm in length was made, after the reduction, the fracture was fixed by lateral locking clavicular plate. Clinical and radiological assessment for fracture union were performed at 3 weeks,12 weeks and 24 weeks interval and results were analysed by using Disabilities of the Arm, Shoulder, and Hand (DASH) score.

Results: 9 patients were followed for 6 months with mean fracture healing time was 24 weeks. 7 patients (77%) had excellent results and 2 patients (33%) had good results according to DASH All of the patients had returned to their preinjury level of sport and activity. None of the patients had a complication. score. No intraoperative complications were found during the operation. All incisions achieved healing.

Conclusion: Open reduction and internal fixation with contoured lateral locking clavicular plate provides better functional outcome in treating medial end clavicular fractures.

Keywords: medial end clavicular fracture, lateral locking clavicular plate, DASH score

Introduction

According to the epidemiology data of clavicular fractures, fractures of the medial end of the clavicle in adults are the rarest of all clavicular fractures [1]. Only 6% clavicular fractures happened at the medial end of the clavicle [2]. Recently, several studies have reported the poor results achieved from the significantly displaced fracture by conservatively treatment [3, 4]. Surgical management is an attractive alternative method for the displaced fractures of the medial end clavicle [5]. However, there was little experience working with this fracture for most orthopedic doctors. In addition, there are vital structures situated under the medial clavicle. Surgery of the medial clavicle remains a challenge for orthopedic doctors [6].

According to the literature, there are no standard surgical procedure for treatment of the displaced medial clavicle fracture. Many surgical approaches have been described, including Kirschner wire, screw, and T-plate fixation. However, the fixation failure rate was high when using the Kirschner wire and screw [1]. Kim *et al*. reported that with T-plate method, the problems of fragment distraction and screw pull-out were common [7]. Recently, several studies have evaluated the treatment procedure of medial clavicle fracture with locking plate [8]. Tokiyoshi and his colleges reported the fixation procedure with a locking plate which was generally used in lateral clavicle fractures [9]. However, the effectiveness of locking plates for the medial clavicle fracture is unclear, because few cases have been reported. However, there are concerns with how well the plate actually fits, plate positioning, and access for accurate screw insertion. Fixing the plate onto the superior surface of the medial end of the clavicle may compromise or damage the clavicular insertion of sternocleidomastoid (SCM) muscle and, due to the close proximity of the patient's head and neck, compromise and limit the number of precisely positioned screws. To avoid potential damage to the SCM muscle, better contour the plate, and aid accurate screw insertion, we have used a lateral clavicle locking plate that is twisted through 90°. This allows for the medial end of the plate to be fixed to the anterior surface of the clavicle with multiple small locking screws and the lateral end of the plate to be twisted and fixed to the superior surface of the clavicle.

In our present work, we described in detail the clinical therapeutic outcomes for the treatment of medial end clavicle fractures with 90 degree contoured lateral clavicle anatomic locking plates in order to evaluate its clinical efficacy and safety

Materials and methods

This Study was conducted in Department of orthopaedics, Mysore medical college and reasearch Institute in association with Krishna rajendra hospital, Mysore for a period of 22 months (from August 2020 to May 2022) with sample size of 9. Detailed history was taken from patient and clinical examination was done according to pre prepared Performa. Patients were subjected for further radiological investigations like x ray and CT scan when

required. The medial-end clavicle fractures were divided into [10]: A-type fracture is defined as undisplaced fracture, and B-type fracture as displaced fracture according to Edinburgh classification method. Nine cases had obvious displacements, which were classified as type B; 8 cases were type 1B1 (extra-articular), one case were type BO (intra-articular)

Inclusion criteria include

1. Patients aged between 18 to 70 years with medial end clavicle fracture which are either intra or extraarticular
2. patients medically fit for surgery

The exclusion criteria for the study were

1. 1.Associated lung injury
2. Patients with delayed presentation (> two weeks).
3. Associated injuries that increase the risk of surgery or prevent compliance with subsequent rehabilitation protocols (i.e., severe head injuries, spinal cord injury).
4. compound fractures

Informed written consent was taken from the study subjects after explaining to them the plan, surgical procedure going to be performed and complications associated with it and intention of the study in language best known to them. All of the patients underwent open reduction and internal fixation with a 3.5 mm lateral locking clavicular plate. The locking plate used in the present work has several angle screw holes at one end. The diameter of the hole was 2.7-mm and the locking screws can path through in order to fix the fragments. The other side of the plate was fixed with 3.5-mm locking screws. With helical bending of the plate through 90° around its axis, at the junction between the flared and shaft parts, it can be contoured and fitted in a reverse configuration to the medial clavicle with the 2.7-mm hole flared segment positioned over the anterior surface of the medial clavicle and the shaft section spiraling to fit along the more lateral superior surface.

A mixture of unicortical locking and nonlocking screws was inserted into the flared medial end of the plate from anterior to posterior. Bicortical cortex screws were inserted from superior to inferior into the lateral end of the plate When considering the surgical approach to access the medial end of the clavicle, we took into account protection of the posterior mediastinal structures, the SCM muscle, and soft tissue structures adjacent to the superior surface and the exposure and the drill trajectory for the medial end screws. An oblique transverse incision was made parallel and just inferior to the medial end of the clavicle, stopping just before the midline. Dissection was taken through platysma to expose the anterior surface of the medial end of the clavicle, the anterior SCJ ligament and joint capsule, and the medial edge of the sternum. More laterally, the dissection was developed superiorly to expose the superior surface of the clavicle.

Fig 1: Lateral end clavicle plate precountered at 90 degrees around its axis.

Postoperative management

Postoperatively, the patients were immobilized in a sling for 3 weeks. Progressive physiotherapy was started after 3 weeks and included active and passive flexion and uplifting movements. Within 2 months of surgery, the patients achieved a full range of motion of the shoulder. The patients were able to resume their daily activities and work within 4 months after surgery.

Follow up

All the cases received regular follow-up including a physical examination, an x-ray evaluation, and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. During the follow up, the range of motion of the shoulder and any complications were recorded.

Results

Youngest patients in our series were 28 years and eldest was 62 years old average age was 40.77 years. In our study 6 patients had Right sided injury accounting for 66% of the total patients. In our study the most common mode of injury causing medial end clavicle fracture was Road traffic accident (RTA) 88% followed by fall on outstretched hand with incidence of 12%. Average follow up was 24 weeks (6 months) ranging from 18 to 32 weeks in our study. There

was no loss of follow up and all have completed minimum of 18 weeks follow up. Average duration of surgery was 90 mins (75-105 min).

Table 1: Demographics

Patient	Sex	Age	Mechanism of injury	Side	Fracture type	Dash score	Results
1	M	28	RTA	R	EA	5	Excellent
2	M	36	RTA	L	EA	3	Excellent
3	M	62	Self fall	R	EA	9	Excellent
4	M	45	RTA	R	IA	11	Good
5	F	42	RTA	L	EA	8	Excellent
6	M	29	RTA	R	EA	6	Excellent
7	M	48	RTA	L	EA	7	Good
8	M	34	RTA	R	EA	9	Excellent
9	M	43	RTA	R	EA	5	Excellent

IA-Intraarticular, EA-Extra articular, L-Left, R-Right, M-Male, F-Female

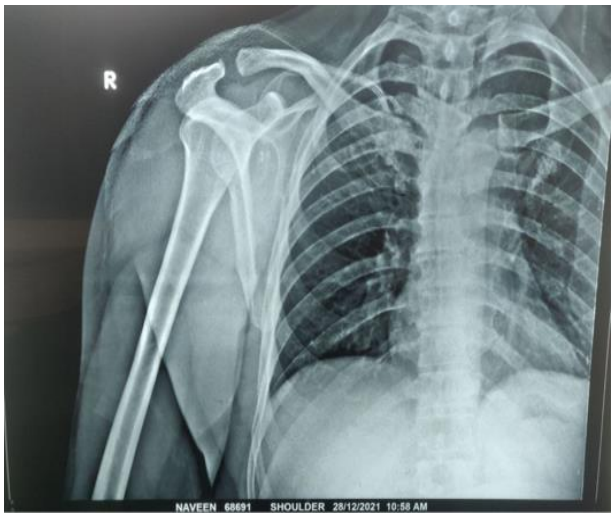
Radiological evaluation confirmed fracture healing in all patients by 16 to 20 weeks. Final evaluation in our series was done at 6 months follow up on the basis of DASH score. In our series 7 patients had excellent results accounting for 77.7%, 2 patients had good results accounting for 22.2%. According to DASH scoring, the mean DASH score was 7.0 (range, 0 to 13).

All patients had returned to their preinjury level of sport, activity, study, or work and had regained a full and equal range of motion at their SCJ compared with the noninjured side. No patient showed fracture instability in imaging or on physical examination. None of the patients had experienced or reported a complication.

Table 2: Results

Parameters	Mean Value
Age	40.77
DASH SCORE AT 6 MONTHS	7.0
Final rating	Good to Excellent
Follow up	6 months

Case 1



Pre op X-ray.

Intraoperative picture

Post op X-ray

Fig 2

Clinical pictures

Fig 3: Follow up clinical pictures of a patient at 6 months with near full range of movements.

Discussion

Aaccording to the epidemiology data of clavicular fractures, fractures of the medial end of the clavicle in adults are the rarest of all clavicular fractures [1]. Only 6% clavicular fractures happened at the medial end of the clavicle [2]. In addition, interpretation of a single radiographic view can be difficult, potentially leading to an underappreciation of medial third fractures [1].

Previously, the tendency was to treat medial third clavicular fractures nonoperatively. This is likely to be due to concerns with the hazards associated with the surgical approach around the SCJ and the medial end of the clavicle and also with achieving adequate fixation of the relatively small medial side bony fragment. However, the nonunion rate was found to be 6.3% for nondisplaced medial third fractures and 14.3% for displaced fractures at 24 weeks after injury [15]. Early anatomic reduction and fixation has been shown to reduce the time to functional recovery, with excellent outcomes and few complications.

Various fixation methods have been advocated to fix medial clavicular fractures. Kirschner wires have been used alone, but these tend to be insufficient and may migrate. A hook plate has been used, with the hook in the sternum itself inducing a temporary arthrodesis; this also requires removal. Tension band sutures have been used, offering limited stability. They are less suitable for larger fragments, although they may be used in combination with a T plate, which may also be used alone [7]. Even a staged procedure of medial clavicular fixation and middle clavicular offloading osteotomy with delayed osteotomy fixation has been attempted [1].

The use of locking plates has been reported with successful results. The most recent and largest series fixed 19 of 20 displaced adult medial clavicular fractures by using a plate. A reversed lateral clavicle plate, made by 3 different manufacturers, was contoured to the anatomy of the superior surface of the clavicle and the medial end fixed with unicortical screws [17]. None of the patients sustained intraoperative damage to any of the surrounding vital soft tissue structures, and all of the fractures healed.

In all of the aforementioned series using a reversed lateral clavicle locking plate to fix a medial third clavicular fracture, the plate has been positioned on the superior surface of the clavicle. However, we were concerned that this position risked interference and irritation of the sternal head of SCM muscle and other soft tissue structures around the superior surface of the medial end of the clavicle and SCJ. We also felt that the proximity of the patient's head and neck would potentially hinder and compromise the ability to obtain the correct drill and screw trajectory into

the medial end of the clavicle to accurately drill all of the potential locking slots available within the flared end of the plate. There was no mention of these concerns in these series. Although it is possible to potentially accommodate the angular mismatch between an inverted, short lateral clavicle plate over the medial end of the clavicle by positioning the medial, flared end of the plate as posteriorly as possible over the superior, medial end of the clavicle, compromising optimal fixation, it is not the case for a long lateral plate. Despite positioning the medial, flared end of an inverted long lateral clavicle plate as posteriorly as possible over the superior, medial end of the clavicle, the last 3 screw holes at the lateral end of the plate will be off of the posterior edge of the clavicle.

To address these concerns, we bent same-sided lateral clavicle plates through 90° around their axis at the junction between the flared and shaft parts. By carefully contouring and controlling the bend, it was possible to align the shaft end of the plate along the superior surface of the clavicle, accurately accommodating the sternal curvature for both short and long plates (Fig. 1). We used anAcumed distal locking plate because this is the plating system that we use in our institution for clavicular fractures. However there is no specific reason why any other proven clavicle distal locking plate made by another manufacturer could not have been used.

Through an inferior anterior approach, to improve cosmesis and minimize wound irritation, the flared end of the plate could be positioned over the anterior surface of the medial end of the clavicle, permitting an unhindered drill trajectory and screw insertion to every screw hole available within the plate. The only compromise is that the preset peripheral locking screw angles in the plate are divergent to accommodate the broader, superior surface of the lateral clavicle. The anterior surface of the medial end of the clavicle is less broad, and some of the peripheral holes may require nonlocking screws.

We consider the contoured, inverted, anterior-superior plate technique to have a number of advantages over an inverted, superior plate technique, but it does have some disadvantages. Although there are a number of benefits in drilling andinserting the screws into the anterior surface of the medial clavicle, it is essential that the drill does not penetrate the posterior cortex of the clavicle and that the screws remain unicortical. The technique also requires significant and careful contouring of the plate around its axial plane.

This study has a number of limitations. The sample size is small, and the patient population is relatively heterogeneous. It is also a retrospective study with a relatively short follow-up and a single-unit case series.

Conclusion

Although limited by the small sample size, our study showed that early fixation and displacement of clavicular fracture can lead to anatomical reconstruction of the clavicle with fewer complications. However, contouring the plate through 90 degrees and placement of the plate, and protection of the sternoclavicular joint, are very critical in the fixation of medial clavicle fractures with reversed lateral clavicle plates.

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