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Outcomes of Displaced Midclavicular Fractures in Adults Treated With 1/3rd Tubular Plate

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ABSTRACT

Clavicle fractures were traditionally treated nonoperatively, but due to higher rates of delayed union, non-union, symptomatic, malunion cosmetic deformity and other complications there is an increasing trend for operative management. Plating and intramedullary nailing are the most popular surgical options. The aim of the study was to evaluate the clinical outcome of displaced midclavicular fractures (DMCFs) in adults treated with 1/3rd tubular plate Prospective study was conducted between 2012 and 2016 in which 32 patients (23 males and 9 females) with mean age of 34.56 years with DMCFs underwent surgical fixation with 1/3rd tubular plate. Evaluation done by constant-murley shoulder outcome and dash scores at 6, 12 weeks, 3, 6, and 12 months to determine outcomes. All the patients achieved clinical and radiological union at 9.66±1.75weeks. The final Constant and DASH scores were 91.09±4.18 and 6.09±1.17. There were no major complications, only minor complications of superficial infection (n=2, 6.25%), deep infection (n=1, 3.13%), hypertrophied scarring without pain (n=2, 6.2%), limited shoulder motion (n=2, 6.25%), screw loosening causing neither pain nor functional disablility (n=1, 3.13%), breakage of plate (n=1, 3.13%). Clavicle fractures are usually treated conservatively but there are specific indications for which operative treatment is needed .In this study 1/3rd tubular plates were used as it can be contoured to the shape of the clavicle and we can conclude that fixation of DMCFs with 1/3rd tubular plate is a effective procedure, which provides good functional outcome, high union rate, return to work, and results with minimal complications in indicated cases.

Keywords: Clavicle 1/3rd tubular plate displaced comminuted.

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INTRODUCTION

Fractures of the clavicle commonly seen by fall on an outstretched hand or by direct injury comprise 35% of all shoulder injuries.[1] They are common injuries in young individuals especially those who participate in activities and sports where high-speed falls or violent collisions are frequent and account for 2.6-10% of all fractures.[2]

The majority of clavicular fractures (80-85%) occur in mid shaft of the bone with over half of these being displaced where the typical compressive forces applied to the shoulder and the narrow cross-section of the bone combined and result in bony failure.[3] In the past decade, operative treatment of dislocated mid shaft clavicular fractures has become more common. The evidence in favor of operative treatment still grows, as recent studies show lower nonunion and symptomatic malunion rates and earlier return to work compared with conservative treatment [4-7].With the development of the more advanced anatomically preshaped plates, the discussion is shifting from indications for operation towards the choice of implant for the midshaft clavicle [8-10]

There are various plates including Sherman plates, dynamic compression plates and semitubular plates. Among them, 1/3rd tubular plate which can be bent to the S-shaped curvature of the clavicle, yields a very good result.

MATERIALS AND METHOD

This study describes a prospective study in all patients with a displaced midshaft clavicular fracture treated with a 1/3rd tubular plate between 2012 and 2016 in a teaching hospital in Dibrugarh, Assam. Patients were included for analysis if they met the following

Inclusion criteria

- Fully displaced, midshaft clavicular fracture (fracture type Robinson 2a/2b) [10]
- ≥ 2 cm shortening,
- Compromised skin,
- Skin tenting
- Open fractures,
- Neurovascular injury

Exclusion criteria

- Fracture older than 2 weeks
- Nonunion or malunion of a previous fracture.
- Pathological fractures

Operative Technique and Rehabilitation

A transverse skin incision was made along the anterior border of the clavicle under general anesthesia or brachial block. Fixation was performed following a reduction with minimal periosteal stripping. Each plate was contoured to the shape of the clavicle and applied on anterior surface. To obtain maximum fixation strength, ≥ 3 screws were used in the proximal and distal areas, respectively. If necessary, a circlage wire and lag screw were used in cases where fracture reduction could not be achieved due to a severe comminuted fracture with ≥ 2-3 bone fragments. In cases where severe comminution was observed in the inferior surface of the clavicle, autogenous iliac bone grafting was also performed to avoid nonunion or fi xation failure or metal breakage caused by tension. Bone grafting was performed in 4 cases from autogenous ipsilateral iliac crest an arm sling was used for approximately 2 weeks after surgery, and pendulum exercise and active range of motion exercise were then started.

Assessment of Treatment Outcomes

Postoperative treatment consisted of active non-weight bearing motion exercises of the shoulder throughout the first six weeks. In our study, implant removal was not done routinely. It was done as per need and will of the patient after fracture union. Statistical analyses were performed by using the SPSS 20.0 program. Comparison between evaluative scores at baseline and subsequent follow-ups was done using Wilcoxon Signed- Rank Tests. $p<0.05$ was considered significant.

Absence of pain, tenderness, and frank mobility clinically and trabecular continuity on radiograph were used as criteria to define union. Time to achieve union and to return to normal activities was recorded. All intraoperative and postoperative complications were recorded.

The patients were followed up postoperatively and the constant-murley shoulder score & the Quick Disability of the Arm, Shoulder, and Hand (DASH) scores suggested by the American Academy of Orthopedic Surgeons (AAOS) were evaluated 6 weeks, 3 months, 6 months, and at last follow up at 12 months. An independent t -test and chi-square test were used. A p -value < 0.05 was considered significant. There were no major complications in our study such as nonunion, plate breakage, and refracture.

RESULTS AND DISCUSSION

Out of a total of 32 patients who met the inclusion criteria, there were 23 males and 9 females with a mean age of 34.56 years [SD 11.05, range 19-54 years]. The demographic and clinical characteristics of the patients are given in (Table 1 & 2). Based on OTA classification system, 23 fractures were type B1 and 5 were B2 and 4 were B3. The mean trauma surgery delay was 5.47 days [SD 3.11, range 1-13 days]. 1/3rd tubular plate was used in all the cases. All the patients achieved clinical and radiological union at a mean of 9.66 weeks [SD 1.75, range - 8-14weeks] which was statistically significant (p=0.0093). There were no major complications,

only minor complications of superficial infection (n=2, 6.25%), deep infection (n=1, 3.13%), hypertrophied scarring without pain (n=2, 6.2%), limited shoulder motion(n=2, 6.25%), screw loosening causing neither pain nor functional disability (n=1, 3.13%) (table 4)

Table:1

Characteristic		Study group
Age, years (Mean ± SD)		34.56±11.05
Sex	Male,%	23(71.9%)
	Female,%	09(28.15%)
Side	Left,%	14(43.8%)
	Right,%	18(56.2%)
Fracture type	B1,%	23(71.9%)
	B2,%	05(15.6%)
	B3,%	04(12.5%)
Mode of injury	RTA,%	19(59.4%)
	Fall,%	6(18.8%)
	Assault,%	3(9.4%)
	Others,%	4(12.5%)

Table 2

Age in years	No of fracture
20-30	13
31-40	9
41-50	5
51-60	5

Table 3

Parameters Analysed	Results
Duration of injury, Days(Mean ± SD)	5.47 ± 3.11
Union , n	100 %
Union time, weeks(Mean ± SD)	9.66 ± 1.75
Final constant score(Mean ± SD)	91.09±4.18
Final DASH score(Mean ± SD)	6.09 ± 1.17

TABLE 4

Complications	No.
superficial infection in 2 cases	2
Hypertrophied scar	2
Limited shoulder motion	2
Painful shoulder	2
screw loosening causing neither pain nor functional disability in 1 cases	1

Operative pics

Figure: clinical pictures showing the operative procedures.

A. reduction of fracture with bone clamps

B. precontouring of the 1/3rd tubular plate

C. plate application

D. screw fixation

E. plate fixed with screws

F. wound closure

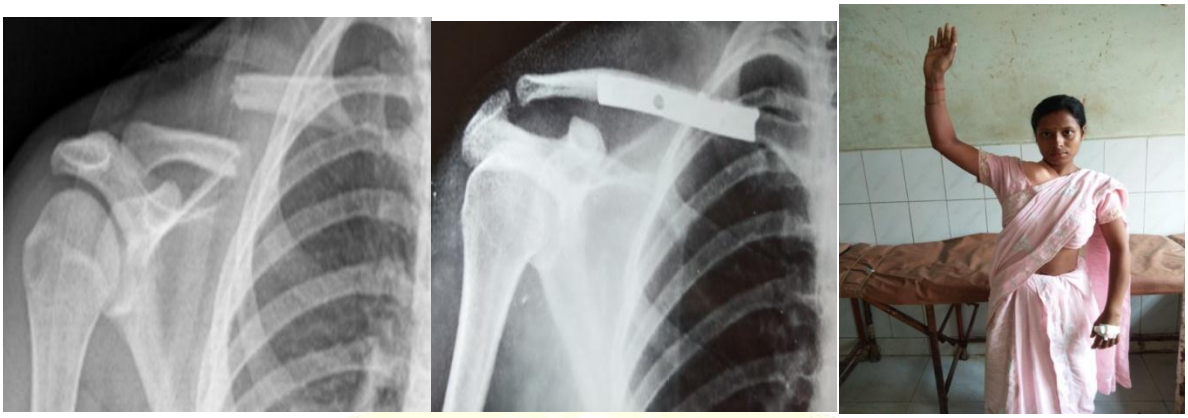

Figure: A. preoperative x-ray

B. immediate post operative x-ray

C. clinical pics showing full range of motion (2wks post op)

The present trend is to treat displaced midshaft clavicular fractures by operative methods owing to high rates of malunion, nonunion, prolonged pain, and disability with nonoperative treatment.[13] Various operative treatment modalities are available including plating, nailing, and external fixation. Plating is the most commonly used procedure and is biomechanically superior to other modalities as it better resists torsional and bending forces.[14]

Traditionally, clavicular fractures have been considered better treated nonoperatively in Neer 6 & Rowe7 m study. But more recently, Robinson et al8. in 2004 described a consecutive series of 868 patients with clavicular fractures, 581 of whom had a midshaft diaphyseal fracture. They found 21% non-union rate for the displaced, comminuted midshaft fractures. A meta-analysis by Zlowodzki et al10. in 2005 of recent studies revealed that the rate of nonunion for displaced midshaft clavicular fractures was 2.2% after plate fixation compared with 15.1% after nonoperative care, a relative risk reduction for nonunion of 86%. That meta-analysis also showed that primary plate fixation was, contrary to prevailing opinion, a safe and reliable procedure. In a 2007 Canadian multi-centric study5, a non-union rate of 14.2% and 3.2% was reported for nonoperative and surgical management respectively. In the 49 patients in their study who were treated nonoperatively and had a healed fracture, 18% had symptoms of malunion and they elected corrective osteotomy.

Difference between the outcome of clavicular fractures in previous reports and those in contemporary studies are thought to be due to the data included on clavicular fractures in children, who have inherent healing abilities and re-modelling potential. Secondly the use of patient-oriented outcome measures, as in the studies by Hill et al.9 and McKee et al11, has been shown to reveal functional deficits in the upper extremity that are not detected by traditional surgeon-based scores. Thirdly, the injury patterns may be changing.

In our Prospective study between 2012 and 2016 in which 32 patients (23 males and 9 females) with mean age of 34.56 years with DMCFs underwent surgical fixation with 1/3rd tubular plate achieved clinical and radiological union at 9.66 weeks. The final Constant and DASH scores were 91, 09 and 6.09. There were no major complications, only minor complications of few superficial infection, deep infection, hypertrophied scarring without pain, limited shoulder motion, screw loosening causing neither pain nor functional disablility.

The present study is compared with Bostman et al [11] which treated middle third clavicle fractures, in 103 patients by early open reduction and internal fixation with plate and screws and yields almost same results.

The limitations in our study were relatively small sample size done at a single centre, short follow-up time, and having no comparison groups. However, we were able to interpret our results by comparison with other studies published in literature using similar methods. Thus, we can conclude that fixation of DMCFs with 1/3rd tubular plate is a effective procedure, which provides good functional outcome, high union rate, return to work, and results with minimal complications in indicated cases.

Ethical Standard Statement:

All patients gave the informed consent prior to being included into the study. All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments. The study was approved by the Research Ethics C

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