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**A COMPARATIVE
STUDY ON PLATING
VERSUS NAILING IN
MIDCLAVICULAR
FRACTURES**

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Abstract

Background: Midclavicular fractures commonly seen fractures around shoulder and conservative treatment methods have been associated with high complications rates (10-15%). Therefore surgical options have better results when managed with clavicular plating or nailing. This study highlights on comparisons between two fixation modalities in midclavicular fractures. Aims : To study and compare mid clavicle fractures fixed with anatomical plate and titanium elastic nailing (TENS) clinicoradiologically and to assess complications related to it.

Materials and Methods: This was a prospective study conducted between August 2016 to February 2018 approved by ethical committee of our Institute. 59 midclavicular fractures were included in the study and were operated with plating and nailing. All patients were assessed clinicoradiologically at 4, 8, 12 and 24 weeks. The functional outcome was assessed by Constant and Murley score. Both operative techniques were compared in terms of radiological union, clinical functions, postoperative pain, hospital stay duration and complications associated.

Results: All patients were divided into two- plating group (n=31) and nailing group (n=28). Radiological union was faster and functional outcome scores were better in nailing group than plating group ($p=0.004265$ and

$p=0.02852$ respectively). Nailing patients also had shorter hospital stay and reduced post operative pain compared plating group. In terms of complications, nailing group had fewer (n=3) complications than plating group (n=1).

Conclusion: In closed mid-shaft clavicle fractures TENS nailing is superior to clavicular plating. Nailing has better functional outcome, faster union, fewer complication, less hospital stay, better patient comfort in terms of reduced post operative pain and cosmetically more acceptable than plating.

Keywords: non union; internal fixation; implant breakage; mid shaft clavicle; nail protrusion

Introduction

Mid-clavicle fractures comprises about 3-5% of all fractures and around 45% of fractures around shoulder[1]. When it comes to distribution of fractures according to the location, mid clavicular constitutes about 70-80%, lateral end of clavicle fractures contribute 15% to 30% ,medial end of clavicle fractures at around[2]. Open clavicular fractures however are quite rare which are seen in 0.1% to 1% of cases. The peak incidence occurs in the third decade of life [2].

Surgery is accepted more and more as primary treatment for displaced mid-shaft clavicle fractures, mainly because the results of non-operative treatment are interpreted as inferior to operative treatment both clinically and functionally[3,4,5]. Also persistent wide separation of fragments with interposition of soft tissue may lead to failure of closed reduction. There is 15% non-union rate in widely displaced fractures of middle-third of the clavicle treated without surgery and all fractures with initial shortening of more than 2 cm resulted in non-union[4].

Several studies have examined the safety and efficacy of primary open reduction and internal fixation for completely displaced mid-shaft clavicle fractures and have noted high union rate with a low complication rate[6,7]. In a large number of complex clavicle fractures a satisfactory outcome is possible with a low complication rate using a locked compression plate[8]. Primary internal fixation of displaced comminuted mid-shaft clavicle fractures leads to predictable and early return to function. Plate fixation options include low contact dynamic compression plate, which are strong, but difficult to contour and causes soft tissue

irritation. Anatomical pre-contoured plate have the potential advantages of not requiring further bending, having a lower profile causing fewer soft tissue problems while retaining the mechanical strength of the stronger plates. Another technique for mid-clavicular fracture fixation which have gained attention over the years with its better clinicoradiological outcome is titanium elastic nailing(TENS). When managed surgically both the options have better outcome than managed conservatively[9].

In this prospective study we aimed to asses two fixation modalities in mid-clavicular fractures and compare them clinicoradiologically and complications associated with them.

Material And Methods

This was a prospective study carried out from August 2016 to February 2018 in the Department of Orthopedics at our Institute. All closed clavicular mid one-third fractures with age more than 16 years were included in the study. Open fractures, pathological fractures and age less than 16 years were excluded from the study. All medically fit patients were admitted and routine radiographs included standard anteroposterior view of affected shoulder. All patients were posted with valid written consent for surgery and were operated on elective basis. Two fracture fixation modalities were used. One is with anatomical clavicular plate- plating group and other one is titanium elastic nailing (TENS)- nailing group.

All patients were operated under general anesthesia in beach chair position.

Surgical Technique for plating

Entire upper limb from base of neck to hand were prepared and

draped with sand bag between the scapula. About 7-9 cm, incision was made in the anterior aspect centering clavicle over the fracture site. The skin subcutaneous tissue and platysma were divided without undermining the edges. The overlying fascia and periosteum were divided next. The osseous ends were freed from surrounding tissue. Minimal soft tissue and periosteum dissection was done. Fracture fragments were reduced and anatomical clavicular plate was applied over the superior aspect of the clavicle and was fixed with locking screws/ cortical screws and minimum three screws in medial and lateral fragment were applied. Wound was closed in layers after ensuring meticulous hemostasis and sterile dressing was applied.

Surgical Technique For Titanium Elastic Nailing

With similar position and draping methods as for plating,a small incision was made approximately 1 cm lateral to the sternoclavicular joint. Titanium elastic intramedullary nail was inserted (the diameter varied from 2 to 3 mm depending on the width of the bone). Before introduction, the original curvature of the small and flattened nail tip was straightened slightly to allow better gliding in the small medullary canal. Closed reduction was performed under fluoroscopic guidance .

The nail was then advanced manually until it was just medial to the acromioclavicular joint. Accurate maneuvering of the nail tip was necessary under fluoroscopic control to avoid penetration of the thin dorsal cortex. After reaching the end point, the fracture was compressed and the nail was cut close to the entry point to minimize soft tissue irritation, at the

same time leaving sufficient length behind for easy extraction later on.

Patients were discharged between 3rd to 5th postoperative day with arm sling. Rehabilitation with pendulum exercises was started at the end of 2 weeks. At 4 to 6 wks gentle range of motion of the shoulder was allowed but abduction in limited to 80 to 90 degree. At 6 to 8 wks active range of motion in all planes were allowed.

All patients were assessed clinicoradiologically at 4,8 12 and 24 weeks.

The functional outcome was assessed by Constant and Murley score at 24 weeks.

Results

The present study consists of 59 patients with fresh middle third fracture of the clavicle among which 31 patients underwent plate fixation (plating group) and 28 patients underwent titanium elastic intramedullary nail fixation (nailing group). There were 27 males and 4 females in plating group whereas nailing group had 25 males and 3 females. The Mean age for plating group was 36.48±11.82 years and mean age for nailing group was 29.61±10.73 years.

The mode of injury was uniformly distributed in both the groups with 60-67% of cases due to road traffic accident, 25% of cases due to fall from height and 6-7 % of cases were due to sports related injuries.

Fracture pattern were classified according to Robinson classification According to Robinson classification, 83.1% cases were simple (B1) type and 16.9% cases were wedge/comminuted (B2) type from the total patient in my study. 71% (22) cases were simple (B1) type and 29% (9) cases were wedge (B2) type in plating group. 96.4% (27) cases were simple (B1)

type and 3.6% (1) cases were wedge (B2) type in nailing group (Table 1).

Table 1: - Distribution of cases according to Robinson classification

Type of fracture	No. of cases with % (Plate group)	No. of cases with % (TENS group)
Type 2b1	22 (71.0%)	27 (96.4%)
Type 2b2	9 (29.0%)	1 (3.6%)

Post operative pain assessment was done with Visual Analogue Score (VAS) at postoperative day 3 and it showed the VAS score for pain was 4 in 11 cases (35.5%) from the plate group and 15 cases (53.6%) belonging to nailing group had a score of 3. The average of the scores among the groups was found to be statistically significant where P=0.004(p<0.05) (Table 2)

Table 2: Distribution of cases according to the pain as per Visual analogue scale (VAS) on postoperative day 3

Pain VAS Scale	No. of cases with % (Plating group)	No. of cases with % (TENS group)
0	0	0
1	0	0
2	4 (12.9%)	8 (28.6%)
3	9 (29.0%)	15 (53.6%)
4	11 (35.5%)	4 (14.3%)
5	7 (22.6%)	1 (3.6%)
6-10	0	0
Total no. of cases	31(100%)	28(100)

Mean postoperative stay duration in hospital was 5±3.09 days (Plating group). Mean postoperative stay duration in hospital was 4±2.73 days (nailing group). Post operative stay duration in hospital is less in TENS group compared to plate group.(Table 3)

Table: 3 Distribution of cases according to the duration of postoperative stay in the hospital

Duration	No. of cases with % (Plating group)	No. of cases with % (TENS group)
1-3 days	10 (32.3%)	21 (75.0%)
4-6 days	16 (51.6%)	2 (7.1%)
>6 days	5 (16.1%)	5 (17.9%)
Total no. of cases	31 (100%)	28 (100%)

In plating group, good union was seen at mean average of 12.23±1.94 weeks (Figure 1). There was one case with union seen at 18th week. From the plate group we had one case with implant breakage and the implant was removed . In the nailing group union was achieved with an average of 10.89±1.79 weeks (Figure 2) and the difference was statistically significant with p<0.05 (p=0.004265). Union was early in nailing group compared to plate group (Table 4).

Table 4: Distribution of case according to the time taken for the union.

Time for union (weeks)	No. of cases with % (Plating group)	No. of cases with % (TENS group)
9-12	19 (63.3%)	23 (82.1%)
13-16	10 (33.3%)	5 (17.85%)
>16	1 (1.3%)	nil
Total no. of cases	30 (100%)*	28 (100%)

The complications were noted in 4 cases overall in our study (6.8%) with 3 cases in plating group and one case in nailing group. The complications involved in plating group were delayed union (n=1), hypertrophic scar (n=1) (Figure 3) and implant breakage with

non-union (n=1)(Figure 4). In nailing group, nail protrusion at posterior cortex of lateral end of clavicle was seen at 12 weeks(n=1)(Figure 5).

Complication were less in TENS group compared to plate group(Table 5).

Table 5: - Major and Cosmetic complications

Complication	No. Of Cases (Plating Group)	No. Of Cases (Nailing Group)
Infection	0	0
Plate loosening	0	-
Plate prominence	0	-
TENS nail protrusion	-	1
Plate breakage	1	-
Non-union	1	0
Delayed union	1	0
Mal-union	0	0
Hypertrophic Skin scar	1	0
Restriction of shoulder motion	0	0

Functional assessment was made with Constant and Murley score at 24 weeks showed excellent in 12 cases (38.7%)(Figure 1) , good in 16 case (51.6%) , fair 2 cases(6.4%) cases and poor in 1 case (3.2%) in plating group whereas nailing group showed

excellent score in 20 cases (71.4%) (Figure 2), good score in 7 case (25%) and fair score in 1 case(3.6%). Nailing group showed better functional outcome compared to the plate group and was statistically significant $p=0.02852$. ($p<0.05$). (Table 6)

Table 6: Distribution of case according to the Constant and Murley score system

Constant and murley score	No. of cases with % (Plating group)	No. of cases with % (TENS group)
Excellent	12 (38.7%)	20 (71.4%)
Good	16 (51.6%)	7 (25%)
Fair	2 (6.4%)	1 (3.6%)
Poor	1 (3.2%)	nil
Total no. of cases	31(100%)	28(100%)

Discussion

Clavicular fractures managed conservatively have complications rates from 10-15% in the form of malunion, non-union, decrease in shoulder power, shoulder stiffness and cosmetic un-acceptability[21,22,23,24]. Therefore surgical treatment seems more suitable to overcome such complications and considered superior to conservative treatment[10]. Open reduction and plating has been standard surgical procedure for clavicular fractures which can be applied anteriorly or superiorly. However intramedullary nailing in the form of TENS has been latest addition in the fracture fixation of clavicle which have given good results functionally mainly due to smaller invasive technique and cosmetically better[12] . In this study we compared the clinicoradiological outcome of clavicle fractures fixed with open reduction and internal fixation with anatomical clavicular plate and TENS nailing by closed reduction under fluoroscopic guidance.

Radiological union in our study showed average time of 12.23 ± 1.94 weeks in plating group which was significantly delayed compared to nailing group with average time of 10.89 ± 1.79 weeks ($p=0.004$). This delay could be due to extensive perisoteal stripping compared to no perisoteal stripping in nailing method as it was done closed. Also, plating gives absolute stability whereas nailing results in relative stability enhancing callus formation by micromotion at fracture site[11]. This result was in accordance with Saha et al. which too showed faster union with nailing group compared to plating group[11].

Functional outcome has been reported better in nailing group than plating group with previous studies.

In Anil et al study, patients treated by plating showed excellent outcome in 60% cases while 84% in nailing group[13]. The mean DASH score was found to be 1.87 ± 3.4 in TENS group and 4.8 ± 5.9 in plate group. Both the scoring system suggested TENS nailing was better than plate fixation. In our study too, the functional outcome was measured by Constant and Murley scoring system showed nailing group with better functions and early good functional outcome than plating group ($p=0.0285$). Plating group showed excellent results in 38.7% ($n=12$), good in 51.6% ($n=16$), fair in 6.4% ($n=2$) and poor in 3.2% ($n=1$) whereas nailing group showed excellent result in 71.4% ($n=20$), good result in 25% ($n=7$) and fair result in 3.6% ($n=1$) ($p=0.02852$).

Both surgical modalities have drawbacks and complications of their own however. Complications related to plating include hardware prominence, implant breakage and refracture, loosening, metallosis, delayed union/non union and infections since it needs opening fracture site[14,15,16,17]. Similarly in our study too there were three cases with complications with implant breakage ($n=1$), non-union ($n=1$) and malunion ($n=1$) with overall complication rate of 6.8%. There was a case of minor complication in the form of hypertrophic scar which was cosmetically unacceptable. On the other hand, complications due to nailing too exist, though fewer. Medial or lateral end of a nail protrusion, skin irritation or penetration, nail breakage and superficial skin infection have been reported [18,19,20]. However we had only one patient with nail protrusion from the posterior cortex of lateral end of clavicle after 5 months of surgery.

Conclusion

In closed mid-shaft clavicle fractures TENS nailing is superior to clavicular plating. Nailing has better functional outcome, faster union, fewer complication, less hospital stay, better patient comfort in terms of reduced post operative pain and cosmetically more acceptable than plating. Limitation of the study, however was small sample size for comparison.

Figures and illustrations



Figure 1. Showing clavicular plating with anatomical locking plate with immediate post operative(b), at 9 weeks(c) and at 12 weeks(d) radiographs. Clinical photographs showing excellent outcome with Constant and Murley scoring system (e,f,g,h).



Figure 2 showing clavicular nailing with TENS with preoperative(a), immediate postoperative(b) and at 9 weeks postoperative radiographs. Clinical pictures showing excellent outcome(d,e,f).



Figure 3 showing hypertrophic scar following clavicle plating



Figure 4 showing implant breakage with non union of clavicle following plating



Figure 5 showing nail protrusion through posterolateral cortex of clavicle

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