



## International Journal of Orthopaedics Sciences

ISSN: 2395-1958  
IJOS 2017; 3(2): 93-98  
© 2017 IJOS  
www.orthopaper.com  
Received: 18-02-2017  
Accepted: 19-03-2017

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### Displaced midshaft clavicle fractures: Conservative VS intramedullary nailing

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DOI: <http://dx.doi.org/10.22271/ortho.2017.v3.i2b.18>

#### Abstract

**Background:** Clavicle fractures are most common and seen across all age groups. The traditional conservative treatment has shown higher incidences of fracture malunion, nonunion, and patient dissatisfaction. Aim is to analyze the outcome of clavicle fracture treated with Intramedullary nailing (IMN) with those treated conservatively in terms of rate of fracture union and functional outcome.

**Materials & Methods:** In this prospective, randomized study of 40 cases with clavicle fracture 20 patients were treated conservatively and 20 with IMN and were followed up at 4th, 8th and 12th week and 6th and 12th month. Time for fracture union was measured radiographically and Functional Outcome was assessed using Constant Murley Shoulder score. Patients with pathological fractures, open fractures, comminuted fractures, segmental fractures and fractures associated with neurovascular injury were excluded.

**Result:** The mean time for fracture healing was significantly shorter in IMN group than conservative group with difference statistically highly significant ( $p < 0.005$ ). There was statistically significant difference between two groups with respect to mean duration for radiological union for Naiking group ( $p < 0.0001$ ) and also with respect to functional outcome at 6th ( $p < 0.0025$ ), 9th ( $p < 0.003$ ) and 12th ( $p < 0.002$ ) month follow-up.

**Conclusion:** In this study Intramedullary Nailing of Midshaft Clavicle Fractures resulted in faster fracture union and Good Functional Outcome compared to those treated conservatively.

**Keywords:** Midshaft Clavicle fracture, operative versus conservative management, outcome, intramedullary nailing, Constant murley score

#### Introduction

Clavicle is the bony link from thorax to shoulder girdle and contributes to movements at shoulder girdle. Clavicle fracture is a common traumatic injury around shoulder girdle due to their subcutaneous position. Fracture of the clavicle accounts for approximately 5 to 10% of all fractures and upto 44% of injuries of the shoulder girdle. The majority of clavicle fractures 80-85% occur in mid shaft of the bone where the typical compression forces applied to the shoulder and the narrow cross section of the bone combined and result in bony failure. Fractures of the clavicle have been traditionally treated non-operatively. In the past few years several publications have described about poor outcomes like malunion and nonunion (15%) and poor functional outcome after conservative treatment of severely displaced midshaft clavicular fractures (MSCFs) [1, 2].

The proponents of early fixation of fresh clavicular fractures is to prevent complications like malunion and nonunion, emphasize the value of accurate reduction and fixation in affording quick pain relief and promoting early functional recovery [1, 2]. In the publication [3] author has described that clavicle can be treated with intramedullary methods like other long bones and thus it is a safe, quicker and minimal invasive procedure.

In this study we would like to analyze the outcomes of the operative management using intramedullary elastic nail and compare its results with older modality of conservative treatment considering it as standard treatment option.

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**Materials and Methods**

The present study was approved by local ethical committee which was carried out from May2014 to May2016 at Orthopaedics Department in Krishna Hospital and Medical Research Centre Karad. In a prospectively randomized study a total of 40 patients with displaced MSCFs were randomized into two equal groups, where one group was treated surgically with elastic intramedullary nailing and other group with figure of 8 Clavicle Brace(FCB). The cases were allotted to each group alternatively in an order to which they arrived to Krishna Hospital on OPD or IPD basis after signing Written Informed Consent. 20 participants were allotted to each group.

**Inclusion criterias:** 1) All the displaced middle third clavicle fractures, 2) Compliant patients of 18-60 yr age who have active recreational lifestyle, 3) Comminuted fractures, 4)Mid shaft clavicular fracture associated with other injury, 5)Medically fit to undergo surgery (ASA grade 1-3).

**Exclusion criterias:** 1) Age <16yrs, 2) Fractures older than 4 weeks, 3) Pathological fractures, 4)Open fractures, 5)Patient refusal, 6) Medically unfit (ASA Grade 4/5), 7)Previous fractures around the clavicle.

All the fractures were classified according to the Robinson’s Classification <sup>[4]</sup> for Clavicle fractures. All patients in operative group were operated within 1 week from the date of admission.

**Conservative treatment technique (fig 1a, 1b)**

Patient was made to sit on stool with back facing surgeon, cotton was applied in axilla, and ready figure of 8 clavicle brace was applied after reducing the fracture by pushing proximal third of fracture. Figure of 8 clavicle brace was tightened to maintain position of clavicle and pulses on both sides were checked after applying brace. Patient was asked to report if he/she felt any tingling or burning sensation following application of brace. Patient’s limb was immobilized in sling.



**Fig 1: (a) – FCB (front)**



**Fig 1: (b) – FCB (back)**

**Surgical technique (fig2a-2e)**

After general anesthesia, the patients were positioned in the supine position with a rolled towel placed in interscapular region to provide extension of the shoulder girdle. The affected upper extremity was draped free to allow manipulation in a sterile manner. The image intensifier was placed in front of the surgeon on the opposite side of the operating table so that perpendicular shots and those with 20-45° of cephalic tilt and 45° caudal tilt could be taken to view the I- and-S-shaped forms of the clavicle, respectively.

A small incision 1-2 cm long is made over the Medial end of clavicle 1 cm lateral to the sternoclavicular junction. Entry was made using a small curved or straight bone awl under the fluoroscopic control in AP and 45 degree Cephalic tilt and 45° Caudal tilt view. Reaming of the medial fragment was done using manual reamers under fluoroscopic control. The nail, which is fixed to a universal chuck with a T-handle, is passed through entry point into the prereamed medullary canal under fluoroscopic control and allowed to exit from the medial fragment. Once the nail reached the fracture site, closed reduction by direct pressure on the fragments combined with manipulation of the arm was performed. The nail is next driven across the fracture site into the medullary canal of the lateral fragment until resistance is felt by the surgeon. To ensure the correct placement and depth of the nail into the lateral fragment, fluoroscopic control is used. The protruding end of the nail is cut off and bent as close to the bone as possible. Using the impact or, the bent end of the nail is impacted to prevent soft tissue irritation. The fascia and skin were closed in layers.



**Fig 2: (a) - Patient's positioning**



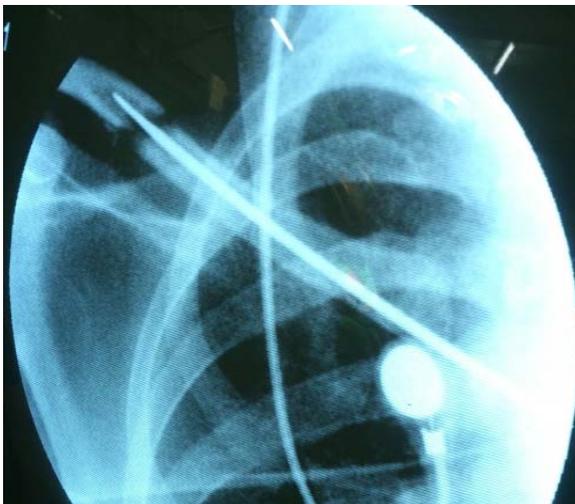
**Fig 2: (b) Patient's draping with marked incision site and affected limb draped free for manipulation.**



**Fig 2: (c)** Entry using bone awl



**Fig 2: (d)** - Nail insertion using t handle



**Fig 2: (e)** Nail Position under C-ARM

### Assessment

For both groups, patients received shoulder sling protection. In operative group it was continued for 2 weeks and in conservative group was for 6 weeks. Dressing was changed on post op day 2 and patient was discharged. Sutures were removed on post op day 10. Patient was then called for

regular follow-up every week for 4 weeks and then at 8 weeks, 12 weeks, 6 months and 1 year. Local examination of the affected clavicle for tenderness, instability, deformity and shoulder movements was assessed. X-rays were taken at each follow up visit to assess the progress of fracture union and implant position.

The functional outcomes were assessed by Constant and Murley Score [5] at 6 months, 9 months and 1 year. The patients were graded as Excellent if score ranges from 90-100, Good for 80-89, Fair for 70-79, and poor if score is less than 69. Radiographic healing was defined as obliteration of fracture line and bridging callus. Clinical union was defined as absence of tenderness at fracture site. Complications such as malunion, non-union, implant irritation, wound infection were recorded.

Statistical analysis was done by descriptive statistics as mean, SD, proportions/percentages etc. Comparison of variables/parameters in Operative and Conservative treatments groups was done by Student's Unpaired and Paired 't' test at 5% and 1% level of significance. Z Test of proportion association was applied to test the difference between proportions of different variables in both the groups under the study. Statistical analysis software namely SYSTAT version 12 (made by Cranes software, Bangalore)

### Results

Our study consists of 40 patients of fresh displaced mid shaft fracture of the clavicle who were treated surgically with titanium elastic nail and conservatively with figure of 8 clavicle brace between May 2014 to May 2016. All the patients were available for follow-up. Results were analyzed both clinically and radiologically.

In our study there were 30 males and 10 females with Right side of MSCFs seen in 28 patients. The mean average age in operative group was  $31.80 \pm 11.23$  and in conservative group was  $35.10 \pm 12.58$ . Most of the MSCFs were due to RTA (road traffic accidents) which was seen in 33 pts, 2 were due to fall from height, 2 due to assault and 3 due to sport injuries. In our study MSCFs was associated with many other injuries such as Head injury in 5 pts, Mandible fractures in 2 pts, Chest trauma with rib fractures in 2 pts, Pelvic fractures in 3 pts and tibia fracture was seen in 2 pts. All the fractures were classified according to the Robinson's Classification. In our study we had 33 pts with type 2B1 fractures. (Table 1)

The union was assessed on the basis of radiographs, mean duration of union in operative group was  $15.4 \pm 5.9$  weeks and in conservative group was  $26.5 \pm 4.8$  weeks. Functional outcome was evaluated on the basis of Constant Murley Shoulder score at 6 months, 9 months and at 1 year which is described in Table 2.

Thus at final evaluation the overall grading of the results in operative group was 16 excellent and 4 good, while in conservative group there were 12 excellent, 5 good, 2 fair, and 1 poor results. Thus the values of Radiological Union and the Functional outcome in operative group are highly statistically significant as compared to the conservative group. Few complications (fig 5a to 5c) were also seen in our study in both the groups. There was 1 non union, 7 malunions and 1 delayed union in conservative group. Whereas in operative group there was 1 case of delayed union due to comminution at fracture site and 4 patients complained of medial cut end prominence with skin irritation, which ultimately went into implant removal after fracture union on opd basis under local anaesthesia. Thus the complication rate is minimal as compared to conservative group.

**Table 1:** Characteristics of patients of both groups

	Operative group		Conservative group	
Male:female	16	4	14	6
Right:Left	12	8	16	4
Average Age (years)	31.80 ± 11.23		35.10 ± 12.58	
Cause of injury				
RTA	15		18	
Fall from height	1		1	
Sport Injuries	2		1	
Asssaut	2		0	

**Table 2:** Radiological and Functional Outcome

	Operative Group (mean ± SD)	Conservative Group (mean ± SD)	't'	P value*
Radiological Union	15.4 ± 5.9	26.5 ± 4.8	6.52	<0.0001
Constant Murley score				
6 months	84.2 ± 9.1	75.3 ± 8.3	3.23	0.0025
9 months	89.5 ± 5.6	82.1 ± 6.2	3.96	0.003
1 year	93.5 ± 6.4	87.6 ± 4.7	3.32	0.002

SD=standard deviation, t= unpaired t test, \*= stat test



**Fig 3a:** Post Trauma



**Fig 3b:** Post-Op



**Fig 3c:** Follow-up radiograph with complete bone union at 6 months



**Fig 4a:** Post Trauma



**Fig 4b:** 6 months Follow-up



**Fig 4c:** Follow-up radiograph with complete bone union at 6 months.



**Fig 5a:** Medial Cut End prominence in Nailing Group



**Fig 5b:** Malunion in Conservative group



**Fig 5c:** Nonunion in Conservative Group

## Discussion

Clavicle fractures for long have been treated with conservative means in form of sling, figure of 8 bandages, plaster etc in which there was union but with some deformity in displaced fractures. As the interest in operative treatment has increased it has progressed from open reduction and fixation to closed reduction and fixation. But still operative treatment has not replaced conservative treatment and most of clavicle fractures are usually treated conservatively.

In a study conducted to analyze the results of conservative treatment by Hill *et al* [6] in 1997, Nordqvist *et al* [7] in 1998 and Robinson *et al* [4] in 2004 found poor results following conservative treatment of displaced middle third clavicle fracture. In a meta-analysis of the literature from 1975 to 2005, Zlowodzki *et al* [10] found that the non-union rate for non-operatively treated displaced midshaft clavicle fractures was 15.1%, exponentially higher than previously described [1, 8, 9]. Good results with high union rates and low complication rates have been reported from a variety of techniques for primary fixation of displaced fractures of clavicle [1, 11]. So there are specific indication like displacement, with or without comminution for middle third clavicle fracture (Robinson Type-2B1,2B2) for which operative treatment is needed.

Currently, plate fixation and intramedullary elastic nails are the available methods for severely displaced MSCFs. In this study, Intramedullary Nailing was compared with conservative management with Figure of Eight Clavicle Brace for displaced MSCFs in adults.

A total of 40 cases with MSCFs were selected for the study. Of these 20 patients were managed by nonoperative method with FCB and another 20 patients by Intramedullary Nailing. In this study, the average age of the patient was 31.80 years in operative group and 35.10 in conservative group, with the youngest patient being 20 years and the oldest being 55 years old, among them, male predominance was present (75%) and female were (25%). Pearson *et al* [12] have reported the average age of patients sustaining a clavicular fracture is 33 years. Postacchini *et al* [22] reported that most patients were men (68%).

In this study, 80% developed clavicle fracture following RTA with direct impact on the shoulder girdle, followed by fall on out stretched hand in 5%, physical assault in 5% and due to sport injuries in 7.5%. Zlowodzki *et al* [10] and McKee *et al* [1] described a fall or a blow to the shoulder, giving an axial compressive force on the clavicle, is the most common trauma mechanism of injury for any clavicular fracture.

Associated injuries commonly noted in this study were head injury in 12.5%, Mandible fractures in 5%, chest trauma in 5%, pelvic fractures in 7.5% and tibia fracture in 5%. Associated injuries have been reported in different studies [1, 10, 12, 13, 14, 15, 16].

The mean time for fracture healing (radiological union) was shorter in the operative group (15.4 weeks) than nonoperative group (26.5 weeks). McKee *et al* [1] described the mean time for fracture healing were 14-16 weeks for operated patients and 24-28 weeks for nonoperated patients.

The complications were more in the nonoperative group like symptomatic malunion 7 cases (35%), non-union in 1 case (5%) and Malunion in 1 case (5%). The complications noted in the operative group were Medial cut end prominence in 4 cases (20%) and delayed union in 1 case (5%) due to comminution at fracture site. None of the operated patients had nonunion or malunion.

No infection was seen in the operative group. All surgical

wounds healed between 8 and 12 postoperative days. Refracture and nonunion were seen in neither of the groups. McKee *et al* [1] reported the rate of nonunion in the nonoperated patients 14-24%, and 3.2% in the operated group.

Iatrogenic neurovascular vascular injury is an imminent complication if proper operative techniques are not followed. Because major neurovascular structures like subclavian vein, subclavian artery and brachial plexus are near to the surgical field [17, 18, 19, 20, 21]. However, in this study, none of our operated patients developed any neurovascular injury.

The Constant Murley Score at 6 month, 9 months and 1 year follow up was evaluated. Mean score for operative group was 93.5 and for conservative group was 87.6, which is statistically significant.

## Conclusion

So elastic stable intra medullary nailing is recommended for all simple displaced midshaft clavicle fractures, for improved functional outcome, shorter time for union compared with nonoperative group at 1 year follow-up and minimal complications. Thus primary operative intervention in clavicle fracture in active adults may be of immense importance.

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