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### Comparative analysis of functional outcome of midshaft clavicular fractures treated by nonoperative method and elastic nailing

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#### Abstract

**Introduction:** Till the end of nineteenth century, the clavicle fractures were managed conservatively. Recent studies have showed that there is a higher rate of nonunion and alteration of shoulder biomechanics in subgroups of patients with these injuries. The flexible titanium elastic nail has more advantage to accommodate for the “S” bend of clavicle is a new concept. In this study we analyse the functional outcome of management of midshaft clavicular fractures treated by elastic nailing and compared it with the outcome of conservative management.

**Materials and Methods:** A cohort of 30 cases were studied for a period of 1 year postoperatively for the functional outcome of elastic nail for midshaft fracture of clavicle.

**Result:** This study comprised of 30 patients and followed for minimum of 12 months. Success rate is 100% union at anatomical position without any complication were reported in patients treated with elastic nail.

**Conclusion:** We recommend Titanium elastic nail of 2-3mm diameter for displaced midshaft clavicle fractures. Surgical management has excellent functional outcome in patients having severe displacement and shortening of more than 1.5 to 2cms.

**Keywords:** Clavicle fracture, Elastic Nail, Functional Outcome

#### Introduction

Clavicle is the most frequently fractured bone of the human skeleton [1]. The incidence of these fractures has a bimodal distribution with peak under 40 years and above 70 years. The majority of fractures (80 to 85 %) occur at the midshaft of clavicle where the typical compressive forces are applied to the shoulder and the narrow cross section of the bone combine and result in fracture [2-4].

Patient-oriented outcome measures were largely missing from earlier reports on the outcomes of these injuries. About 10 to 30% of patients treated nonoperatively develop unsatisfactory outcomes clinically, radiologically and subjectively because of shortening of bone, nonunion and malunion with poor alignment or deformity [5 6]. Along with the traditional treatment of plate fixation, intramedullary fixation with titanium elastic nail is gaining popularity. Intramedullary fixation with titanium elastic nail is a good alternative surgical method with clear advantages for the patient [7-9]. The concept of early surgical fixation and exact postoperative protocol all have convincingly improved the good functional outcome of the patient to a larger extent [10].

#### Aim of the Study

This series aim to study the functional outcome of midshaft clavicular fractures (30 cases) managed by nonoperative method (15 cases) and by elastic nailing (15 cases).

#### Materials and Method

This is a prospective study of 30 cases of midshaft clavicle fractures treated by nonoperative method and by elastic nailing. Patients were explained about the management protocol and consent has been obtained. The period of study and follow up extends from November 2010 to November 2011, in the Department of Orthopaedics, Tirunelveli Medical College and Hospital.

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**Inclusion criteria**

1. age > 20 years
2. midshaft clavicular fracture
3. threat of skin perforation at the fracture ends.
4. associated other injuries.

**Exclusion criteria**

1. age < 20years
2. fracture of lateral 1/3<sup>rd</sup> and medial 1/3<sup>rd</sup>
3. comminuted fractures
4. nonunion
5. pathological fractures
6. open fractures

All the patients were received in the casualty department. After resuscitation, primary screening done. If any other associated injuries present it was treated primarily, radiograph (AP view) of both the clavicles was taken. After considering the inclusion and exclusion criteria, patient was initially applied with "figure of 8 bandage" and cuff and collar. Planning of further treatment was based on demand of the patient, amount of displacement of fracture, skin condition at the fracture site and other associated fractures. Based on this, our study had 2 groups of 15 cases each, managed by nonoperative method and by elastic nailing.

**Management of Nonoperative cases**

Patients were immobilized by "figure of 8" bandages with arm sling. Pendulum exercises was started only when the pain has subsided, usually by the end of 2<sup>nd</sup> week. Periodic tightening of the bandages was done every week upto 3<sup>rd</sup> week. Bandages was maintained for 3-4 weeks. Return to earlier activities like office job was allowed as soon as the patient felt comfortable. Return to strenuous activities like manual labour was advised only after a minimum period of 3 months.

**Management of Operative cases**

Most of the cases were operated on 2<sup>nd</sup> - 5<sup>th</sup> day after admission.

**Operative Technique**

Prophylactic antibiotic was given. Patient was placed on a radiolucent operating table in supine position with sand bag between the interscapular region and hands draped free with a head ring. Under general anaesthesia, a skin incision of 1-2 cm was made 1.5 cm lateral to sternoclavicular end. An opening was made in the anterior cortex of the clavicle with a 2.5mm drill bit and widened using a small bone awl. The titanium nail of 2-2.5 mm diameter was fixed in a universal chuck with a T handle. With oscillating movements the nail was advanced upto the fracture site. To ensure correct placement of nail in the lateral fragment image intensifier was used. If closed reduction was unsuccessful an additional small incision was made over the fracture site to negotiate the fragments. The nail was advanced into the lateral fragment. The nail was cut off at the site of insertion leaving about 1 cm for removal. Skin was sutured without drain. There was no intraoperative or immediate postoperative complication during our study.

**Postoperative protocol**

In the immediate postoperative period the arm is supported in a sling for comfort. The wound is checked and radiograph taken on 2<sup>nd</sup> post-op day and gentle pendulum exercises are allowed. Patient discharged on 5<sup>th</sup> post-op day. On 12<sup>th</sup> day

after surgery sutures were removed, the sling is discontinued and unrestricted range-of-motion exercises were allowed, but no strengthening, resisted exercise or hard work was allowed. At 6 weeks radiograph is taken to evaluate bony union.

If acceptable the patient is allowed to begin resisted and strengthening activities. In one case of delayed union, aggressive activities was avoided until 12<sup>th</sup> week. In our study, all the 15 cases had good radiological union in anatomical position by the end of 16<sup>th</sup> week.

**Implant removal**

Elastic nail was removed only after radiological evidence of union. Of the 15 cases operated nail was removed in 10 cases. Nail extraction is a simple intervention and was performed as an outpatient procedure.

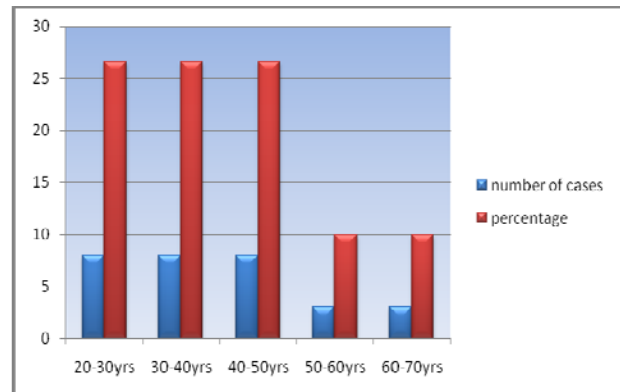
**Statistical Analysis**

All the cases were analyzed as per the following criteria:

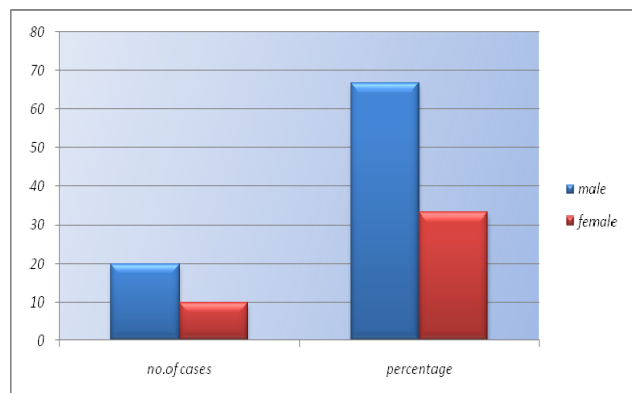
1. age distribution
2. sex distribution
3. side of injury
4. mode of injury
5. classification of fracture
6. planning of treatment
7. time interval between injury and surgery
8. associated injuries
9. complications
10. duration of hospital stay
11. size of nail
12. implant removal

**I. Age Distribution**

Commonest age group 20- 50 years.

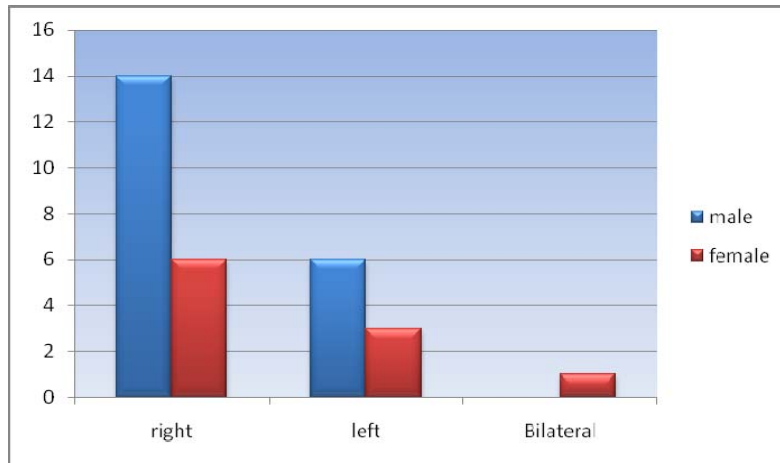
**II. Sex Distribution**

Among 30 cases, males were predominant.



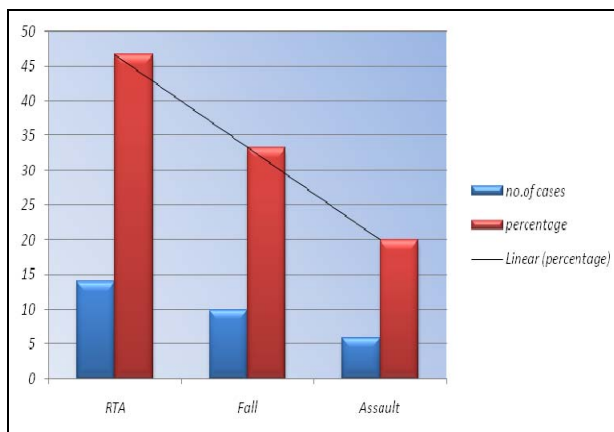
### III. Side of Injury

Right side was common in our series.



### IV. Mode of Injury

Commonest mode of injury had been Road traffic accident.



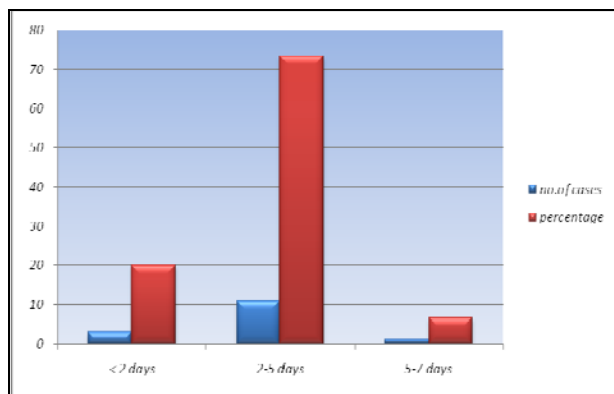
### V. Classification and Type of Fracture

All cases were Robinson Type 2 B1 classification.

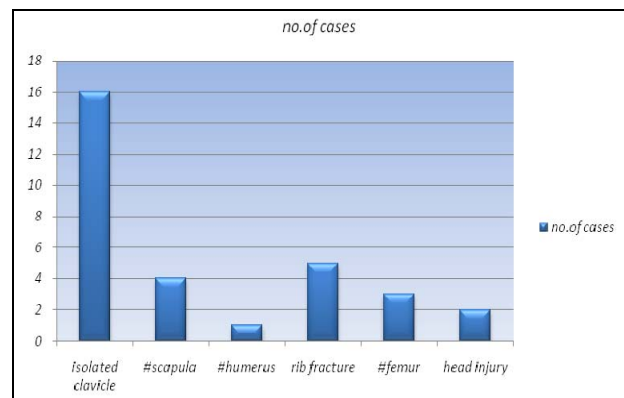
### VI. Planning Of Treatment

Day 1 after injury, to decide for nonoperative or elastic nailing.

### VII. Time Interval between Injury and Surgery



### VIII. Associated Injuries



### IX. Complications

#### Nonoperative Method

S. No	Complication	No. of cases
1	Malunion	3
2	Deformity	1
3	Stiffness of shoulder	1
4	Nonunion	2
5	Delayed union	1

#### Operative Method (elastic nailing)

S. No	Complication	No. of cases
1	Medial nail migration	2
2	Skin irritation	1
3	Delayed union	1

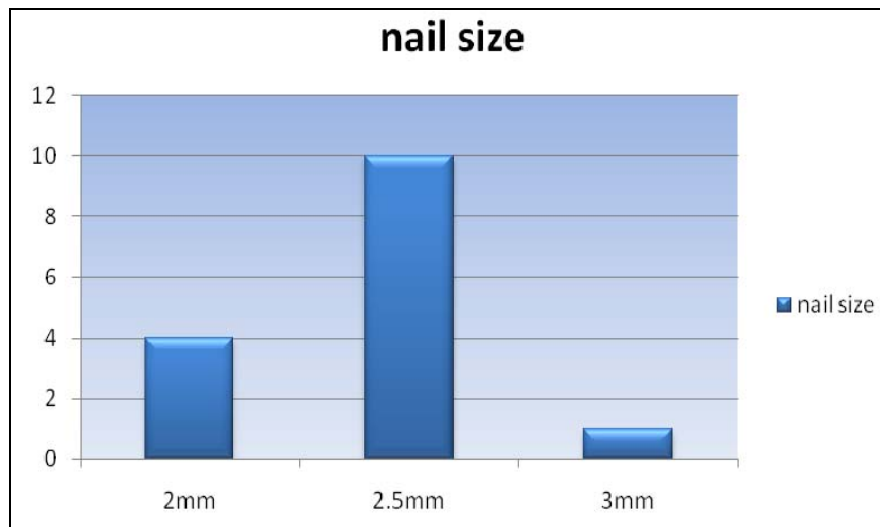
In the operative method, for 2 cases of nail migration and 1 case of skin irritation the fracture had united radiologically and the titanium elastic nail was removed at 16<sup>th</sup> week. No other procedures were performed other than nail removal. No case of infection or shoulder stiffness was reported during our study.

**X. Duration of Hospital Stay**

Procedure	Total Duration Of Stay
Non-operative	4-5 days
Elastic nailing	7-9 days

**XI. Size of Nail Used**

Common size of nail used in South Indian adults.



**XII. Implant Removal**

Of the 15 cases operated, elastic nail was removed in 10 cases. The only indication for nail removal is evidence of radiological union. Average period of nail removal is 16 - 20 weeks.

**Results of Our Study**

Results	Conservative (15)	Elastic Nail (15)
Union in anatomical position	10 cases	15 cases
Union in 12 weeks	12 cases	14 cases
Union in 16 weeks	1 case	1 case
Nonunion	2 cases	-
Malunion	3 cases	-
Early return to activity	1 month (10 cases)	1 month (12 cases)
Stiffness of shoulder	1 case	-
Loss of length of clavicle (shortening > 2cms)	4 cases	-
Patient compliance and functional outcome	Excellent - 7 cases Good - 6 cases Moderate - 1 case Poor - 1 case	Excellent-13 cases Good - 1 cases Moderate - 1 case Poor - 0
Other Complications	Cosmetic deformity - 4 cases	Nail migration - 2 cases Skin irritation - 1 case Infection - 0

**Discussion**

Clavicle fractures, one of the common fractures of adult population are often treated conservatively since the time of Hippocrates. Thorough understanding of the musculoskeletal anatomy and the dynamic relation between clavicle and shoulder motion is essential in management of clavicle fractures. The deforming forces, the degree of comminution and overriding causes shortening of the clavicle. Shortening more than 2 cms influences the outcome in the midshaft clavicle fractures.

Based on review of various studies on management of clavicle fractures by conservative methods, the effectiveness of nonoperative management is found to be deficient in providing optimal outcome particularly in young population.

We evaluated 30 cases of midshaft clavicular fractures treated by non operative methods (15 cases) and by titanium elastic nail (15 cases). Our mean functional outcome in cases treated by nonoperative method was 86.5% and in cases treated by elastic nailing was 91.5%. About 66% of patients treated by nonoperative method had union in anatomical position but in cases of elastic nailing it was 100% with p-value of 0.0143 (chi-square test). Hence patients treated by elastic nailing had 34% more chance to achieve union in anatomical position. Overall patient compliance and functional outcome was excellent in cases managed by elastic nailing was 86% with p-value of 0.02 (normal p <.05).

### Analysis of Various Studies

Results	Zlodowski <i>et al</i> (2005) 2144 cases			Thiyagara- jan <i>et al</i> (2005)		Zlodowski <i>et al</i> (2007)		Smekal <i>et al</i> (2009) 60cases		Chen QY <i>et al</i> (2011) 60cases		Our study (2011) 30cases	
	Non operative method	Plating	Elastic nailing	Non operative method	Elastic Nailing	Non operative method	Plating	Non operative method	Elastic Nailing	Non operative method	Elastic Nailing	Non operative method	Elastic Nailing
Nonunion	5.9%	2.5%	1.6%	24%	Nil	7	2	3	Nil	3	Nil	2	Nil
Malunion	-	-	-	-	-	9	Nil	2	Nil	2	Nil	3	Nil
Infection	-	2.4%	-	Nil	Nil	-	-	Nil	Nil	Nil	Nil	Nil	Nil
Nail migration	-	-	-	-	-	-	-	-	-	-	5	-	3

Our study analysis was able to be compared with other study results with excellent statistical significance.

### Conclusion

The conclusion of this study is, most of the midshaft clavicle fractures were treated nonoperatively till now. The nonoperative method remain the standard for the majority of minimally displaced or undisplaced fractures in elderly individuals and in patients with less demand. But there is increasing evidence of encouraging results in patients treated by elastic nailing. It is an alternative and effective minimally invasive technique with least complications, excellent functional outcome with early mobilization and good result. It maintains the length of the clavicle. This study shows the expanding surgical indications in these previously under-appreciated injuries.

We recommend Titanium elastic nail of 2-3mm diameter for displaced midshaft clavicle fractures. Surgical management has excellent functional outcome in patients having severe displacement and shortening of more than 1.5 to 2cms.

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