

A Comparative Study of Functional Outcome of Midshaft Clavicle Fractures Treated by Locking Plate versus Minimally Invasive Titanium Elastic Nail Fixation

Biswajit Das¹, Suresh Chandra Pal²

^{1,2}Assistant Professor, Department of Orthopaedics, F.M Medical College, Balasore, Odisha, India.

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ABSTRACT

Background: Clavicle fracture is common fracture in orthopaedics practice because of its subcutaneous and anterior position. Mid third part clavicle fractures are the most common. Previously conservative treatment of clavicle fracture was very common but was not so popular because of complications like mal-union and non-union. Now a days in displaced mid shaft clavicle fracture, operative treatment remains the standard procedure for fixation. Our aim was to study the outcome of midshaft clavicle fractures treated by locking plating versus minimally invasive titanium elastic nail fixation. **Methods:** This was a prospective study of 40 patients who were randomized in two groups to be treated surgically with either plate (group A-20 patients) or a single TEN fixation (group B-20 patients). All patients were followed up at 4th week, 12th week and 24th week. Results were compared for outcomes using DASH Score (The Disabilities of the Arm, Shoulder and Hand Score). **Results:** DASH Scores of patients at 24 weeks in both groups, was found to be not statistically significant which shows that, patients undergone plate fixation or intramedullary fixation have similar out come at 24 weeks. **Conclusion:** This study shows that operative treatment with plate fixation or intramedullary fixation by titanium elastic nail, for clavicle fractures have comparable functional outcome.

Keywords: Clavicle fracture, plate and screws, intramedullary titanium elastic nail, DASH score.

INTRODUCTION

Fractures of the clavicle is common and account for 2.6–4 % of all adult fractures, 35 % of all injuries to the shoulder girdle. 69–82 % of these fractures occur in the middle-third.^[1] Displacement occurs in about 73 % of all midshaft clavicle fractures.^[2] The average age of patients sustaining a midshaft clavicular fracture is 33 years out of which 70 % of the patients are male.^[3] Displaced midshaft fractures have usually been treated non-operatively. However, recent studies have found higher rates of delayed union, nonunion, shoulder pain, and shoulder weakness and residual pain with non-operative treatment.^[4] The indications for surgery include the need for earlier functional mobilization in the patient with an isolated injury, in addition to open fractures, floating shoulders and patients with polytrauma.^[5] For operative

treatment, the available methods of fixation are fixation with Kirschner wires, pins (Rush pin, Knowles pin, Rockwood pin), plates with screws and external fixation.^[6] This prospective comparative study was done to compare outcomes and complications of titanium elastic intramedullary nailing and precontoured plating in displaced midshaft clavicular fractures.

MATERIALS AND METHODS

This study was done to compare the functional outcome of midclavicular fractures in two treatment groups. This study was undertaken in the Department of Orthopaedics, F.M Medical College, Balasore, Odisha, from Jan 2019 to Dec 2019. All the patients were randomly divided into two groups, Group A (n-20) and Group B (n-20). Informed written consent was taken from every patient and approval was taken from the college ethical committee. Analysis of results was done by using DASH Score⁷ (The Disabilities of the Arm, Shoulder and Hand Score).

Inclusion criteria-

1. Unilateral displaced midclavicle fracture

Name & Address of Corresponding Author

Dr Suresh Chandra Pal,
Assistant Professor
Department of Orthopaedics,
F.M Medical College, Balasore,
Odisha, India.

2. No medical contraindication to G.A.

Exclusion criteria

1. Age <18 and >60 yrs
2. Fracture >1 month old
3. Pathological fracture
4. Open fracture and comminuted fracture

Group A underwent intramedullary fixation by titanium elastic nail and group B underwent open reduction and plating as treatment procedure. All cases were initially investigated with 20° cephalad anteroposterior and thorax showing bilateral clavicle posteroanterior radiograph to assess fracture type and post traumatic clavicular shortening. A single preoperative dose of prophylactic antibiotics was given.

Elastic nail fixation

Patient was placed on radiolucent operative table in supine position with a large bump placed between the scapulae, allowing the injured shoulder girdle to fall posteriorly, helping to restore length. The insertion point was made approximately 1 cm lateral to the sternoclavicular joint. A one centimeter skin incision was made and a hole is drilled over the anterior cortex with a 2.5mm drill bit and guide. The entry portal may be enlarged with an awl and then an elastic nail (diameter between 2 to 3.5mm) inserted in the medullary canal of the clavicle with a universal chuck and T-handle under fluoroscopic control. With oscillating movements the nail is advanced until it reaches the fracture site. Reduction was performed by manipulating the fracture while moving the free-draped arm or with the help of pointed clamps or towel clips. If closed reduction was unsuccessful, an additional skin incision of size 1-2cm was made parallel to langens line for open reduction of the fragments. After adequate engagement of the distal fragment, the medial end of nail shortened and skin closed over it. Care was taken to avoid perforation of dorsolateral cortex of the lateral clavicle. The procedure is performed under fluoroscopic guidance.

Plating procedure

A single preoperative dose of prophylactic antibiotics was given. The patient was placed in the supine position with a large bump placed between the scapulae, allowing the injured shoulder girdle to fall posteriorly, helping to restore length and exposure to the clavicle. The entire upper extremity was draped free to allow manipulation, if needed. The skin incision was centered over the fracture and followed a line connecting the sternal notch to the anterior edge of the acromion. Dissection was first performed along the medial fragment which has usually flexed up away from the vital infraclavicular structures. If possible, supraclavicular nerves are identified and spared. Reduction was then performed and held with bone

holding clamps. A 3.5 mm Recon plate, LCDC, or third-tubular plates was then contoured with bending irons for application to the superior surface of the clavicle or anteroinferior surface. The fracture was reduced and fixed on the superior surface or anteroinferior surface of the bone using a minimum of three screws in the main proximal and distal fragments. In the case of long oblique or wedge comminuted fractures, lag screws were used where possible with care being taken to preserve soft tissue attachments. For comminuted fractures, a sufficiently long plate with nine or 12 holes was used to bridge the fracture and obtain at least six cortex fixations on each side of the fracture.

Postoperative protocol

Slings were used for 7-10 days then active range of motion exercises were initiated and encouraged to use the arm without heavy lifting, pushing and pulling activity. After operation patient took diclofenac 50mg twice daily for 2-3 days. Full return of activities was permitted once healing occurred. Active movements of the shoulder (over 90° abduction or flexion) was limited for 3-4 weeks, since increasing rotational loads on the clavicle may result in proximal migration of the nail. The results of the study were evaluated primarily by using DASH Score (The Disabilities of the Arm, Shoulder and Hand Score) at preop, at 4 weeks, at 12 weeks and 24 weeks. Statistical analysis was done by using SPSS 16.0 version software. For comparison of means between two groups, unpaired student t-test was used.

RESULTS

The study comprised of total of 40 patients who were divided into two groups to be treated surgically with either plate (plate group) or a single TEN fixation (TEN Group).

In Plate group the mean age of the patients was 35.64 years with standard deviation of 15.44 while mean age of the patients for intramedullary group was 34.15 years with standard deviation of 14.37. In plate group 15(75%) patients were male and 5(25%) patients were female while in intramedullary group 14(70%) patients were male and 6 (30%) patients were female.

Comparison of DASH Score between patients who underwent plate fixation and intramedullary fixation for clavicle fractures at 4 weeks is found to be statistically significant with P-value less than 0.01. Thus showing patients undergone plate fixation has better recovery in 4 weeks post-operative period. [Table 1]

Comparison of DASH Score between patients who underwent plate fixation and intramedullary fixation for clavicle fractures at 12 weeks is found to be statistically significant with P-value less than 0.01. Thus showing patients undergone plate

fixation has better recovery in 12 weeks post-operative period. [Table 2]

Comparison of DASH Scores between patients at 24 weeks post-op treated by plate fixation and DASH Scores of patients at 24 weeks post-op treated by intramedullary fixation, it is found to be

statistically not significant with P-value more than 0.01. This shows that, patients undergone plate fixation or intramedullary fixation have similar outcome at 24 weeks and both techniques are equally effective in treatment of clavicle fractures. [Table 3]

Table 1: Comparison of DASH Score between patients who underwent plate fixation and intramedullary fixation for clavicle fractures at 4 weeks.

Technique	Patients	Mean	SD	Median	Min-Max.	P-value
Plate fixation	20	59.12	±4.11	57.25	51.22-67.29	<0.01
Intramedullary fixation	20	65.95	±4.67	68.89	51.86-69.16	

Table 2: Comparison of DASH Score between patients who underwent plate fixation and intramedullary fixation for clavicle fractures at 12 weeks.

Technique	Patients	Mean	SD	Median	Min-Max.	P-value
Plate fixation	20	25.38	±5.25	27.23	19.47-39.11	<0.01
Intramedullary fixation	20	28.29	±4.63	29.39	21.79-42.12	

Table 3: Comparison of DASH Score between patients who underwent plate fixation and intramedullary fixation for clavicle fractures at 24 weeks

Technique	Patients	Mean	SD	Median	Min-Max.	P-value
Plate fixation	20	6.35	±3.9	6.36	2.35-19.57	>0.01
Intramedullary fixation	20	6.12	±4.5	5.89	1.99-20.11	

DISCUSSION

The best treatment procedure for displaced midshaft clavicle fractures remains a topic of debate. Conservative management of these fractures results in an approximately 5 % nonunion rate.^[7] While non-operative management remains the mainstay of treatment for most midshaft clavicle fractures, the indications for surgery may be expanding. Recent studies have showed a poorer outcome in cases of displaced midshaft clavicle fractures that were treated non-operatively in comparison to surgically treated patients.^[8-11] Three types of fixation are available for middle-third clavicle fractures: intramedullary devices, plates, and external fixators. Intramedullary fixation can be done by smooth or threaded K-wires, Steinman pins, Knowles pins, Hagie pins, Rush pins or cannulated screws.^[12] Plate fixation can be done with a 3.5-mm dynamic compression plate (DCP), low-contact dynamic compression plates, reconstruction plates or locking compression plates with at least three screws in both the medial and lateral fragment each, and an interfragmentary lag screw whenever the fracture pattern allows it. Plating of acute clavicle fractures is advocated as the preferred fixation method by many authors. Biomechanically, plate fixation is superior to intramedullary fixation because it better resists the bending and torsional forces that occur during elevation of the upper extremity above shoulder level.^[13] Patients treated with plate fixation can be allowed full range of motion once their soft tissues have healed. Disadvantages of plate fixation include the necessity for increased exposure and soft tissue stripping, increased risk of damage to the supraclavicular nerve, slightly higher infection

rates, and the risk of refracture after plate removal.^[14] Currently, open reduction and internal fixation with a 3.5-mm dynamic compression plate is the standard method; however, intramedullary fixation is an equally effective alternative.^[15] Bo'stman et al.^[16] studied 103 patients treated with open reduction and internal fixation using plates; among those patients, 43 % had complications; 15 % major complications; 14 % required re-operation and there was an implant failure rate of 14.6 %. Chen et al.^[17] reported a 7.1 % implant failure rate. Liu et al.^[18] compared titanium elastic nail and reconstruction plate fixation in displaced midshaft clavicle fractures and found no significant difference between intramedullary and plate fixation after 18 months in terms of functional outcome and complications. They reported an implant failure rate of 8.5 %. Ferran et al.^[19] compared Rockwood pin fixation (17 cases) and low contact dynamic compression plate (LCDCP; 15 cases) in displaced midshaft clavicle fractures and found no significant difference after 12 months in functional outcome. Complications occurred in 12 % of the intramedullary fixation group and in 40 % of the plate fixation group. Bohme et al.^[20] reported the same conclusions in their study comparing plating, intramedullary fixation and conservative treatment in displaced midshaft clavicle fractures. Thyagarajan et al.^[21] retrospectively evaluated 51 patients (three groups, each had 17 patients) with midshaft clavicle fractures. Group 1 underwent intramedullary stabilization using clavicle pins. Group 2 underwent open reduction and internal fixation using plates and group 3 underwent nonoperative treatment with a sling. In group 2, two (12 %) patients had prominent hardware causing

discomfort, and they underwent removal of hardware 12 months following the fixation. After implant removal results were satisfactory and there was no incidence of refracture. In a retrospective study done by Wu et al.^[22] comparison between plating and intramedullary nailing for the treatment of clavicular nonunion showed an 18.2 % nonunion rate with plating compared with 11.1 % for nailing, the difference being attributed to the nails resistance to & compressive stresses. The primary limitation of our study was that it was a small prospective comparative study including a small number of patients and done at a single center. Larger randomized controlled trials are needed to further evaluate outcomes and complications of precontoured plates and EIN in displaced midshaft clavicle fractures.

CONCLUSION

We can conclude from our study that both precontoured plating and intramedullary flexible nailing are equally effective alternatives for surgical fixation of displaced midshaft clavicular fractures.

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