

Evaluation of treatment of fractures of the middle third of the clavicle by titanium elastic stable intramedullary nails

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Abstract

Background

Treatment of fractures of the middle third of the clavicle was usually conservative but the resultant shortening , disfigurement and the high rate of unsatisfactory results make the operative treatment is another good option.

Plating is one of the options provides immediate stability but the prominence of the plates usually causes skin irritation and the large skin incisions with the excessive soft tissue dissection may lead to delayed union or nonunion.

Patients and methods

Twenty five patients of fracture of the middle third of the clavicle underwent closed or open reduction through a small incision at **Misr University for science and technology hospital** in the period between January 2012 and June 2014.

All fractures were from type A and type B according to OTA classification

The age ranged between 16 to 45 years. The follow up period ranged between 6 to 24 months. The Right side affected in 15 cases while the left side in 10 cases. 17 cases were males and 8 cases where females.

Results

All cases united in a period ranged between 6 to 10 weeks with average 6.4 weeks. No nonunion was reported in this study .superficial infection was reported in 3 cases 2 out of them at the small skin incision and one at the point of entry and all were treated by antibiotics and frequent dressings. The DASH score was ranged between 0 to 21.3 with average 10.3. No reported cases of nail migration.

Conclusion

Fixation of simple or bending wedge fracture of the midshaft of the clavicle by titanium elastic stable intramedullary nails is an easy , safe and effective method with less complication, rapid healing and excellent recovery.

Key words

Middle third tibia- titanium Elastic nails- intramedullary nails.

Introduction

Fracture of the clavicle is the commonest fracture representing about 2.6% to 5% of adult population fractures. About 80% of these fractures are located in the middle third of the clavicle due to the change of contour of the bone and lack of attached ligaments [1-2].

Traumatic fall on an outstretched hand is usually the main mechanism of injury and to a little extent, direct trauma to the clavicle either from anterior to posterior or from above downwards [3]. After fractures, the displaced fragments tend to shorten the clavicle. The sternomastoid muscle tends to displace the proximal fragment superiorly and posteriorly, and the pectoralis major, the deltoid, and gravity tend to displace the distal fragment anteriorly and inferiorly [4]. Displaced midshaft fracture of the clavicle represents

about 50% of the fractures of the midshaft. In displaced fractures, the nonunion rate is about 15.1% while it is about 5% in non-displaced fractures [5].

Conservative treatment with its various modalities as arm-to-chest bandage, simple sling, or figure-of-eight bandage may results in malunited fractures with about 30% unsatisfactory results [6]. The disfigurement and the resultant shortening of the clavicle make the surgical treatment a good option. Plate fixation with different types of plates as the reconstruction plates, one-third tubular plates, and locked plates are widely used for midshaft fracture fixation of the clavicle.

Plate fixation offers both immediate fracture stability and rigid fixation. Large scars, numbness, prominence of the plates under the skin, and excessive periosteal stripping with the possibility of delayed union or

nonunion are from the complications which may occur after plate fixation [7].

Intramedullary fixation of midshaft fractures of the clavicle with its different modalities as elastic stable intramedullary nails, k-wires, and rush-pins may be applied either with closed reduction techniques or via small incision. This technique provides less soft tissue dissection, decrease the incidence of infections, minimal skin irritation due to the absence of plates under the thin skin around the clavicle, and decrease the development of paresthesia and numbness which may occur with large incisions for plating [8-9-10-11]. [Usage of External fixators in midshaft clavicle fractures is generally restricted to open fractures [12].

Patients and Methods

Between January 2012 and June 2014, 25 patients with fracture of the midshaft of the clavicle at Misr University for Science and Technology (MUST) hospital underwent reduction either closed or open through a small incision and intramedullary fixation by elastic titanium stable intramedullary nails.

The inclusion criteria were:

1. Fracture of the midshaft of the clavicle type A (simple) and type B (bending wedge) according to OTA classification[13]:
2. Closed fractures.
3. Complete displacement and shortening of more the 2 cm.
4. Age between 16 and 45 years.
5. Fractures within 7 days from the injury.

The exclusion criteria were:

- Pathological fractures
 - Open fractures
 - Fractures with vascular or neurological injuries
 - Fractures with failed previous treatment
- The age ranged between 16 to 45 years with average 29.5 years.
 - 17 cases were males while 8 cases were females.
 - The right side affected in 15 cases while the left side in 10 cases
 - According to OTA classification, the fractures were:
 - Type A in 13 cases
 - Type B in 12 cases

Operative treatment

- General anesthesia was used in all cases
- Prophylactic antibiotics in the form of 3rd generation cephalosporin were administered to all cases.
- The beach chair position and image intensifier were used in all surgeries.
- A stab incision was done 1 to 1.5 cm lateral to the sternoclavicular joint (Figure 1) for the entry point which was done by a small awl (Figure 2)
- The tip of the titanium elastic nail was bent in all cases to allow easy gliding inside the medullary canal and to add a three-point fixation by anchorage in the cortex.
- The nail is introduced until it reaches the fracture site and the reduction is made by closed measures. Then, the nail is introduced in the distal fragment (Figure 3 and 4). If closed reduction failed, a small transverse incision is done to allow direct open reduction and nail introduction into the distal fragment.
- The medical end of the nail at the point of entry is bent then cut, and left protruded for easy removal later after fracture healing (Figure 5)
- Prophylactic postoperative antibiotics were applied for 2 days.
- An arm sling is used in all cases for 2 weeks and active limited range of motion exercise was applied in all cases.



Fig (1): photo of the incision.



Fig (2): Photo for the use of the awl for entry into the medulla



Fig (3): Photo shows introduction of the nail into the distal fragment.

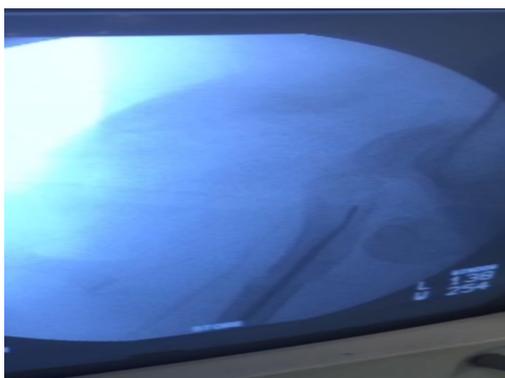


Fig (4): an image intensifier photo during application of the nail



Fig (5): Photo showing the left protruding nail at the entry point.

All cases were evaluated postoperatively clinically and radiologically for reduction, the position of the nail, wound condition if a small incision was made for an easier reduction and by using the disability arm shoulder and hand (DASH) scoring system (0 is best and 100 is worst) [14]. The range of the follow-up period is from 6 months to 24 months. In all cases, the nails were removed after complete clinical and radiological healing usually between 6 to 10 weeks in the outpatient clinic.

Statistical methods:

SPSS© Statistics version 22 (IBM© Corp., Armonk, NY, USA) was used for statistical analysis. Expres-

sion of numerical data were demonstrated using either mean and standard deviation or median and range as seen appropriate. Expression of qualitative data are demonstrated by frequency and percentage. For quantitative data, two groups comparison was calculated using Mann-Whitney test. Significant results were considered when P-value < 0.05.

Results

All cases achieved union in a period between 6 and 10 weeks with average 6.4 weeks. No reported cases of nonunion or delayed union (figure 6,7,8,9). Refracture was reported in one case after six weeks from fracture healing and removal of the nail. The case was treated in a conservative manner using an arm sling, and the fracture showed no displacement. The patient achieved healing after eight weeks and was satisfied without any disability.

No cases of implant failure or migration were recorded. Superficial infection was reported in 3 cases; 2 of them were in the small wound centered over the fracture to facilitate reduction. The third case was around the point of entry at the protruded nail. Infection subsided in all cases after frequent dressing and antibiotics.

The final DASH score at the final follow up varied between 0 and 21.3 with average 10.3.

Statistical analysis to the relation between the final DASH score with time to surgery and time to union was insignificant p value = 0.124 and 0.124 respectively and it is significant with age p=0.001 (table 1). This proves that the younger the age the better the results and DASH score.



Fig (6): preoperative X-Ray



Fig (7): Postoperative X-Ray



Fig (9): X –Ray after nail removal.

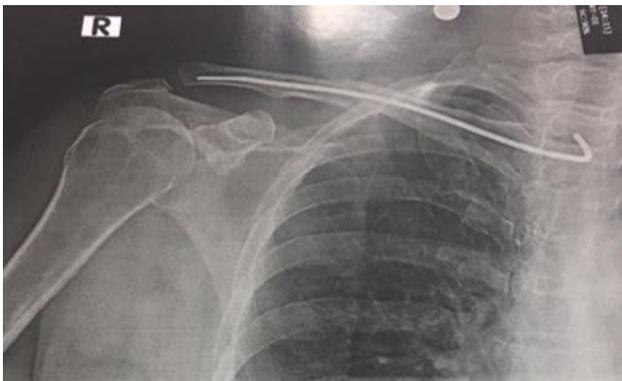


Fig (8): X ray after 2 months with complete healing.

Table (1): Correlation of final DASH score with age, time to surgery and time to union

	Correlation Coefficient	p value
Age (years)	0.634	0.001
Time to Surgery (days)	0.084	0.690
Full Union (weeks)	0.316	0.124

Statistical analysis revealed that the effect of sex, side of fracture, and method of reduction on the final DASH score were insignificant. (table 2)

Table (2): Effect of sex, side of fracture and surgical approach on the final DASH score

	Final DASH score		p value
	Median	Range	
Sex			
Male	10.5	0.0-21.3	0.538
Female	13.8	0.0-20.3	
Side of fracture			
Right	10.5	0.0-20.3	0.596
Left	14.9	0.0-21.3	
Surgical Approach			
Closed	10.6	0.0-20.3	0.259
Mini-open	18.1	0.0-21.3	

Discussion

Fractures of the midshaft of the clavicle are usually treated by conservative measures which include simple sling, pouch arm sling, arm to chest bandage and the figure-of-eight bandage. Often, the fractures unite in a position of malunion after the conservative

management which may affect the shape and function. Shortening of about 20 mm may lead to symptoms like pain, weakness, paresthesia, and easy fatigue [15-17].

The resultant shortened clavicle decreases the muscle tension and hence affects strength, and also causes

changes in the load in the sternoclavicular and acromioclavicular joints leading to early degenerative changes [18].

The trend to fixation of the clavicle after anatomical reductions increased to achieve proper function and better shape. Methods of fixation are plating, intramedullary elastic nails, and fixators.

The use of plates in the superior or anterior surfaces provide rigid fixation and allow early range of motion but need large skin incisions with excessive soft tissue stripping and loss of fracture hematoma which have an important part in fracture healing. The prominence of the plates and heads of screws under the slim skin around the midshaft of the clavicle usually cause skin irritation. [19-20-21]

The intramedullary fixation with its different modalities provide another good option for fixation of fracture of the midshaft of the clavicle.

Some surgeons recommended plating in comminuted fractures and nailing in displaced non comminuted fractures to avoid clavicular shortening [22-23].

In this study shortening lesser than 10 mm were reported in 3 cases and they were able to do all the tasks of the DASH score without difficulty at the final follow up. Bending of the nail tip in all cases facilitates the advancement of the nail to the lateral end of the clavicle and its anchorage to a cortex provide more stability and prevent clavicular shortening.

Also the curved tip with the entry point and the change of contour of the clavicle provide three point fixation which add more stability and prevent shortening.

The DASH score in this study is ranging between 0 and 21.3 with average 10.3 due to the inclusion criteria and all cases from type A and B and comminuted fractures were excluded also the age of the patients between 16 to 45 years and the time between the initial injury and surgery is ranged from 0 to 7 days which allow closed reduction and only five cases were subjected to a small skin incision to facilitate elastic nail introduction via the distal fragment.

The nail size in this study varied from 2 to 3 mm and larger nails were avoided for easy application and to prevent the possible iatrogenic fracture which may occur if a large diameter nail was applied in the narrow medulla of the clavicle.

Nail migration was not reported in this study, the nail is left protruding from the point of entry and bent 90 degrees and cut. It prevents migration and allows easy extraction compared to other studies which reported

rates of migration up to 26.6% [21-22-23]

The time to union varied between 6 weeks to 10 weeks with average 6.4 weeks the shorter time due to the closed reduction in most of the cases and the type of fracture (simple or bending wedge).

Conclusion

Fixation of fractures of the middle shaft clavicle by titanium elastic stable intramedullary nails in cases of simple fracture or bending wedge with displacement and shortening after closed reduction or with a small skin incision is a safe effective method, avoids skin complication, provides stability and with high rate of rapid union.

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