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Original Article

Evaluation of Outcome of Shaft of Clavicular Fractures Treated with Locking Compression Plates and Screws

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ABSTRACT

Background: *Clavicular fracture is a common traumatic condition encountered around shoulder region in adult population, while shaft of fractures are found to be a most common variety. Management trends have changed in recent years from conservative to surgery, considering the higher rates of malunion, nonunion and poorer functional outcomes when managed non-operatively. An open reduction and internal fixation with locking compression plates has been a backbone of treatment of these fractures for several years with the aim of anatomical reduction, stable fixation and early rehabilitation of affected shoulder.* ***Objective:*** *To evaluate the outcome of Shaft of clavicular fractures managed surgically with locking compression plates.* ***Methods and materials:*** *Prospective study of 20 adult patients with shaft of clavicular fractures managed surgically with locking compression plates from December 2019 to February 2020 at the department of orthopaedics of Sher-E-Bangla Medical College, Barishal, Bangladesh. Outcomes were evaluated radiologically as well as functionally on the basis of Constant and Murley's scoring system.* ***Results:*** *Union was achieved in 98% patients with an average duration of 4.16 months with standard deviatio were excellent in 80% and good in 17%. There were two major complications, one requiring reoperation and hardware emoval due to deep infection while other went into nonunion. One patient sustained re-fracture within 2 weeks following implant removal after another trauma.* ***Conclusion:*** *Outcome of surgery was satisfactory with desirable result in almost all of the patients. The surgery was simple, easy to perform and was free from radiation exposure.*

Keywords: *Constant's score, Non-union, Plate exposure, Refracture, Clavicular fracture*

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INTRODUCTION

Fracture of clavicle is a common skeletal injury around shoulder region due to its subcutaneous location. It accounts for almost 3-5% of all fractures in adult

population [1, 2, 3]. Indirect trauma to the shoulder is associated most frequently with clavicle fractures, Fall on an affected shoulder leading to bending force account for most (87%) of the clavicle fractures, while direct impact results in 7% and falls onto an outstretched hand may lead to 6% of all clavicle fractures[2]. Although rare, clavicle fracture may occur secondary to muscle contractions during seizures or secondary to minimal trauma due to pathological bone or as stress fractures[4]. The injury is more common in males as compared to females[2]. The standard treatment for midshaftclavicular fractures in adults has been conservative by an arm sling and a clavicular brace or a figure of eight bandage. But because of higher incidence of re-displacement, malunion, nonunion, prolonged immobilization and also the idea of moving a fractured limb soon after injury; there has been shift of trend from managing these fractures from conservative to surgical fixation with an intramedullary or an extra medullary devices[5,6]. Of these two open reduction and internal fixation with locking plates enables an anatomical reduction, offers a stable fixation and allows early mobilization of fractured limb. The operative method has improved patient-oriented outcomes compared to that of non-operative treatment; considering incidence of non-union, functional outcome, pain scores, quality of life, cosmetic aspects and complications[5,6,7].

It has been observed that middle third fracture is the most common site of fracture, being the junction between the two cross-sectional bony configuration and lack of reinforcement by muscles or ligaments distal to the subclavius insertion, resulting in additional vulnerability[8].

OBJECTIVES

In this study, angulated or displaced Shaft of clavicular fractures were selected for an internal fixation with locking plate and results of surgical the treatment were evaluated.

METHODS AND MATERIALS

Informed consent was taken from the patient and only those willing to take part in this study were included.

Inclusion criteria:

Patients of age Age>18 years of both gender

Displaced clavicle fractures (ALLMAN GROUP I, II, III)

A fracture that had occurred less than two weeks previously.

Bilateral clavicle fractures

Written informed consent

Exclusion criteria:

1. Age < 18 years
2. Open fractures
3. Patient not fit for Surgery

Surgical technique

Under general anesthesia, patients were placed in beach chair position with a bolster placed in between two scapulas. An appropriate size plate was placed on anterosuperior surface having at least six cortices purchase on either side of fracture. One, two or three lag-screws screws were used as an adjunct for interfragmentary compression on larger fracture fragments.

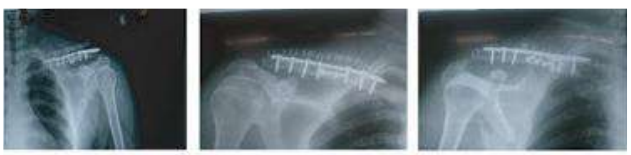

Fig.1: Lag screws used to achieve interfragmentary compression

For comminuted fractures, fixation was supplemented with an autologous cancellous bone graft taken from iliac crest (**Fig. 1**). The wound was closed over layers and the arm was placed in a sling.

Active assisted exercises were started as soon as the patient was comfortable. Arm pouch sling was given for every patient for two weeks. The sutures were removed after 14 postoperative days. Patients were followed up every month till there was an evidence of clinical and radiological union. Union was assessed clinically by absence of pain, tenderness and mobility at fracture site and radiologically by evidence of consolidation. Functional evaluation of shoulder range of motion was done according to Constant's score (**Table 1**) [5,12,13,14].

Table I: Interpretation of Constant score[14]

Constant score	Interpretation
<30	Unsatisfactory
30-39	Fair
40-59	Good
60-69	Very good
>70	Excellent

Deep infection was defined as an infection requiring implant removal, while superficial infections healed with an intravenous antibiotics and a regular change of dressing[15].

RESULT

Results were evaluated radiologically and on the basis of functional assessment in 20 patients with Shaft of clavicular fractures who were included as per inclusion criteria and underwent surgical fixation with locking compression plates. The patients were followed up for an average of 14 months (range, 12-16).

The injury was common between 30 to 40 years of age with an average age of 37 years with standard deviation of 8.42. Males were more commonly injured 65%. The most commonly observed fracture pattern was 2B1, 64%. Motor vehicle accident contributed the maximum number of patients 43% (**Fig. 2**).

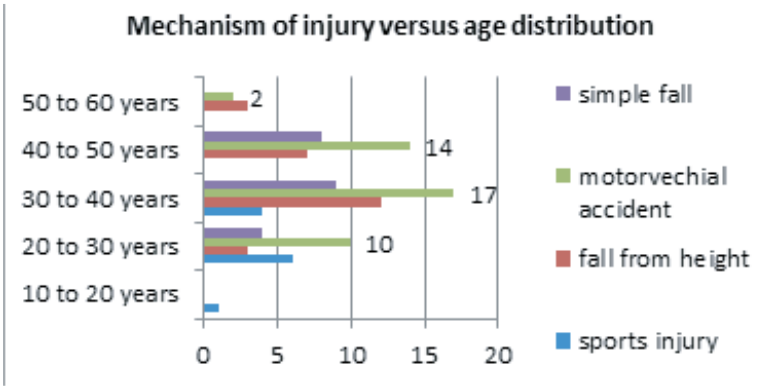

Fig. 2. Mechanism of injury versus age distribution

Union, both clinical and radiological, was achieved in most of the cases (98%) with an average duration of 4.16 months, standard deviation of 1, 23.

One Patient came with an exposed implants after a period of 6 months. The patient denied any further intervention. Plate was removed as per patients wish and no further management was done (**Fig.3**). On subsequent follow up he had fair functional outcome and opted to stay as such with physiotherapy.

Fig. 3: Nonunion with plate exposure

One patient developed re-fracture within two weeks of implant removal following another trauma for which re-plating with bone grafting was done (**Fig. 4**).

Fig. 4: Re-fracture after implant removal

One patient had malunion (**Fig. 5**) due to implant loosening, but had good functional outcome.

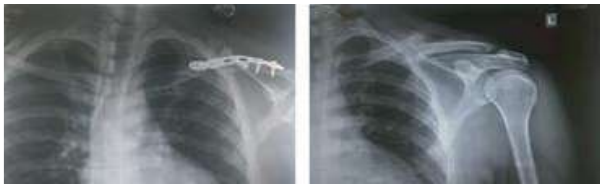

Fig. 5: Malunion in post-operative patient after implant removal

Complications of plating of clavicle fracture are shown in **Fig.6**

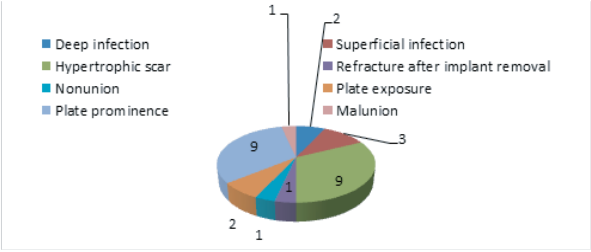

Fig.6: Complications of plating of clavicle fracture

Functional outcome was excellent in 14 patients, good in 2 and fair in 4 patients (**Fig.7, 8**) among those one had non-union while the other had re-fracture after implant removal for which revision plating was done.

Fig. 7: Functional outcome after final follow up according to Constant's score

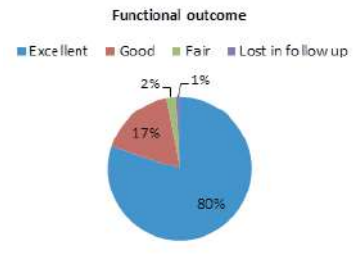

Fig. 8: Shoulder range of motion at final follow-up the implants were removed in 45 patients

DISCUSSION

Traditionally clavicular fractures were managed with an arm sling and a figure of eight bandage or a simple arm sling alone. However neither of these techniques aid in direct reduction of fracture. Besides, it has also been observed that a figure of eight bandage carries a risk of an axillary pressure sores and compression of neurovascular bundles. Recent studies have also illustrated a poor functional outcome and a higher rate of malunion and nonunion after nonoperative treatment, while the results of surgical management have improved substantially[16,17].

Altamimi et al. in his comparative study between non operative treatment versus primary plate fixation for displaced fractures concluded that plating group had better functional outcomes, lower rates of malunion and nonunion and a shorter time to union[18].

Several intramedullary nails have also been used for internal splintage of displaced midshaft clavicle factures; like Kirschner's wires, Knowels pins, Hagie pins, Rockwood pins and titanium nails more recently. But negotiation of nails in the medullary cavity of sigmoid shape bone possesses a challenge while the nail should also be strong enough to withstand deforming force across fracture site till it unites 19,20,21,22.

Golish et al. in his study summarized, plates to be more biomechanically superior than intramedullary nails in clavicular fracture fixation21. With the availability of precontoured locking compression plates, less stiffer implants like reconstruction plates have lost their favor in terms picking order being more prone to deform at fracture site.

This prospective study was designed to evaluate the outcome of locking plate for displaced clavicular fracture.

In our study clavicular fracture was found to be more common in males 65% as compared to females 35%. The results were comparable with Toogood et al[2].

Union was seen in all patients except one developed infected nonunion while the other was lost in follow up. Average time to union was 4.16 months with standard deviation of 1.23. The results were similar to that of Ethiraj et al. Functional outcome was excellent in 80% and good in 17%. The results were comparable with that of Kumar Vijay BS 7 and Ethiraj et al[5].

A deep infection in another patient could not be controlled despite aggressive medical treatment and debridement. Subsequently the fracture developed in an established nonunion (Fig.3), but the patient refused any further treatment. That patient had fair functional outcome after implant removal. Shen et al 15 also

mentioned deep infection to cause non-union.

One patient had malunion, most likely due to plate loosen after infection (Fig.5) which was successfully managed with IN antibiotics, eventually the plate was removed and the patient had good functional outcome.

Narsariaet a123 documented 3% refracture after plate removal. In our study, refracture occurred in one patient within two weeks of implant removal, after a simple fall injury for which replating with autologous bone graft was done (Fig.4).

Of minor complications, superficial wound infection in 3 patients were controlled with an intravenous antibiotics and a daily change of dressing for 7-10 days. All had good functional outcome. No patient with infection developed osteomyelitis.

Toogood et al in his study mentioned plate prominence in 8% because of lesser soft tissue envelope 2. In our study Plate prominence was seen in 9 patients of which 3 had an excellent functional outcome and 6 had good functional outcome.

CONCLUSION

Being a subcutaneously located bone, clavicle is more prone for fracture. Traditionally displaced midshaft clavicle fractures were treated conservatively which lead to increased rates of malunion and non-union. Of surgical intervention open reduction and internal fixation with pre-contoured locking plates seem to be superior to intramedullary nail. Current trend of management with pre-contoured locking plates allows anatomical reduction, stable fixation and better functional outcome. Early mobilization postoperatively within the limits of pain, allows the patient to return to his activities soon after surgery. The chance of infection however may exist which if superficial, can be managed with IV antibiotics and dressing. Plate prominence seemed to be a common complication because of lack of abundant soft tissue coverage which however had no effect in functional outcome. The surgery is simple and does not requires fluoroscopy, making it more feasible in rural settings as well. Duration of hospital stay is also not much of a concern.

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