

Prospective Analysis of Functional Outcome of Clavicle Fractures Treated by Plate Osteosynthesis

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Abstract

Introduction: Clavicular fractures are common injuries, accounting for 2.6% of all fractures. Fractures of the middle third (or midshaft) account for approximately 80% of all clavicular fractures. Thus, the traditional view that most clavicular fractures heal with good functional outcomes following non-operative treatment is no longer valid.

Aim: The aim of the study is the functional outcome of clavicle fractures treated by plate osteosynthesis.

Materials and Methods: The study is conducted in Madurai Medical College and Government Rajaji Hospital on 20 patients with displaced/comminuted midshaft clavicle fractures. All the patients were treated by open reduction and internal fixation with a 3.5 reconstruction plate and screws.

Results: Of the twenty patients (19 male and one female and most of them aged below 30 years) studied between May 2010 and December 2011, all had primary plate fixation except the one with painful non-union for plate osteosynthesis with bone grafting was done. Three patients were lost to follow-up and the remaining 17 patients had a mean of 15.5 months follow-up. All seventeen patients had fracture union in a mean of 16 weeks. Most of the patients (82%) had constant shoulder scores above 90 with an excellent grade except for three patients. Of these, two had wound infection and function improved after implant removal; one patient was a 60-year-old female who developed shoulder stiffness due to improper follow-up and physiotherapy.

Conclusion: Clavicle fractures should therefore be viewed as a spectrum of injuries with diverse functional outcomes, each requiring careful assessment and individualized treatment. Plate osteosynthesis should be preferred to treat indicated middle-third clavicle fractures inactive individuals.

Key words: Clavicular fracture, Constant-Murley shoulder score, Plate osteosynthesis

INTRODUCTION

Clavicular fractures are common injuries, accounting for 2.6% of all fractures [1]. Fractures of the middle third (or midshaft) account for approximately 80% of all clavicular fractures.^[1,2] The traditional view that most clavicular fractures heal with good functional outcomes following non-operative treatment is no longer valid. Recent studies have identified a higher rate of non-union and specific deficits of shoulder function in subgroups of patients with these injuries.^[3-7] These fractures should,

therefore, be viewed in the spectrum of injuries with diverse functional outcomes, each requiring careful assessment and individualized treatment and when indicated, these fractures should be treated by primary operative fixation.

Aim

The aim of the study is the functional outcome of clavicle fractures treated by plate osteosynthesis.

MATERIALS AND METHODS

The study is conducted in Madurai Medical College and Government Rajaji Hospital on 20 patients with displaced/comminuted midshaft clavicle fractures from May 2010 to December 2011. All the patients were treated by open reduction and internal fixation with a 3.5 reconstruction plate and screws.

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Inclusion Criteria

Patients were included in the study if they had (1) a completely displaced (>2 cm) midshaft fracture of the clavicle (derived by clinical measurement), (2) a comminuted middle third fracture of the clavicle with inferior cortical defect, (3) a clavicle fracture associated with scapular neck fracture (floating shoulder), (4) painful non-union, (5) age between 16 and 60 years, (6) no medical contraindications to general anesthesia, and (7) informed consent.

Exclusion Criteria

Patients were excluded from the study if they had (1) an age of <16 years or >60 years, (2) a fracture in the proximal or distal third of the clavicle, (3) Pathological fractures, (4) Undisplaced or minimally displaced clavicle fractures.

Operative Technique

Under general or anesthesia, the patient is positioned supine with a sandbag beneath the ipsilateral scapula. The involved shoulder was prepared and draped, and an oblique incision was made over the superior surface of the clavicle centering the fracture site. The fracture site was identified, and the fracture was reduced and fixed with a 3.5 mm reconstruction plate after contouring. The plate is applied to the superior surface of the bone, with the goal being a minimum of three screws in the main proximal and distal fragments in most cases. Comminuted fragments were secured with lag screws if possible, with care being taken to preserve soft-tissue attachments. Bone grafting was performed in the case with non-union. The deltoid fascia was closed with interrupted number-1 absorbable sutures as a distinct layer, followed by skin closure. No drains were used. A sling was used for comfort for 7–10 days, and then active range-of-motion exercises were allowed. When fracture union (defined as radiographic union with no pain or motion with manual stressing of the fracture) was evident, typically at 6 weeks, overhead abduction and strengthening were allowed, with a return to full activities at 3 months.

Patients were seen at 6 weeks and 3, 4, 6, and 12 months. The assessment included standardized clinical evaluation and completion of the Constant–Murley shoulder score. Both an anteroposterior and a 20° cephalad radiographs were made for each patient.

RESULTS

Of the twenty patients (19 males and one female and most of them aged below 30 years) studied between May 2010 and December 2011, all had primary plate fixation except the one with painful non-union for plate osteosynthesis with bone grafting was done. Three patients were lost to

follow-up and the remaining 17 patients had a mean of 15.5 months follow-up. All seventeen patients had fracture union in a mean of 16 weeks. Most of the patients (82%) had constant shoulder scores above 90 with an excellent grade except for three patients. Of these, two had wound infection and function improved after implant removal; one patient was a 60-year-old female who developed shoulder stiffness due to improper follow-up and physiotherapy.

Patient Satisfaction

After the surgery, all patients were satisfied with their shoulder except the three patients with complications mentioned above. Between operated and normal clavicle, there was a mean length difference of 0.4 mm.

Return to Work

Of the 17 patients in regular follow-up, thirteen patients returned to their pre-injury work and recreational activity levels. Two patients with post-operative infections did not go to work. The patient with shoulder stiffness found it difficult with her household activities.

Range of Motion

The range of motion was well maintained in all patients except the old lady who developed shoulder stiffness. The values were as of the normal contralateral shoulder, 82% of patients having $>90\%$ of the normal function (excellent grade).

Rate of Union

Fracture union was assessed with clinical and radiological means. Fractures united at an average of 16 weeks.

Complications

Two patients had wound infections and their plates were removed. One patient had hardware prominence. One patient developed shoulder stiffness due to improper follow-up and physiotherapy.

DISCUSSION

There is a general consensus that clavicular fractures are best treated nonoperatively. In the 1960s, Neer and Rowe reported on the non-operative treatment of clavicular fractures.^[3,4] However, more recent studies have shown that the union rate for displaced midshaft fractures of the clavicle may not be as favorable as once thought.

There were no non-union in our study. However, in a prospective, observational cohort study, Robinson *et al.* described a consecutive series of 868 patients with clavicular fractures, 581 of whom had a midshaft diaphyseal fracture.^[8] They found a significantly higher non-union rate (21%) for the displaced, comminuted midshaft fractures ($P < 0.05$).

Similarly, in a study of fifty-two displaced midshaft clavicular fractures, Hill *et al.* reported that eight patients had a non-union and sixteen patients had an unsatisfactory outcome based on patient-oriented measures.^[6] They concluded that displacement of the fracture fragments by >2 cm was associated with an unsatisfactory result.

A meta-analysis of recent studies revealed that the rate of non-union for displaced midshaft clavicular fractures was 2.2% (ten of 460 patients) after plate fixation compared with 15.1% (twenty-four of 159 patients) after non-operative care, a relative risk reduction for non-union of 86%. That meta-analysis also showed that primary plate fixation was, contrary to prevailing opinion, a safe and reliable procedure.^[9]

Modern studies on primary plate fixation of acute midshaft clavicular fractures have described high rates of successful results with rates of union ranging from 94% to 100% and low rates of infection and surgical complications: a recent meta-analysis of plate fixation for 460 displaced fractures revealed a non-union rate of only 2.2%.^[9-11] Plate fixation has been a reliable and reproducible technique with improved implants, prophylactic antibiotics, and better soft-tissue handling. Late neurovascular compromise up to 6% was seen in patients treated conservatively due to non-union and excessive callus formation.^[12] In our study, we had no transient neurological abnormalities.

The range of motion was good and the mean constant score was above 90 in our study. On reviewing the literature, we found that patients treated conservatively had a substantial residual disability of the affected shoulder with minimal muscle strength.^[5,13-15]

The advantages of internal fixation of clavicle fractures, which includes early pain resolution, early return of shoulder function, and potentially early return to work, make it an appealing option for treating displaced fractures in inactive individuals. Many different methods of operative fixation of mid-shaft clavicle fractures have been described. Intramedullary pinning techniques have been associated with a high number of complications, such as pin migration and rotational instability, and fixation with interfragmentary screws or wire sutures show insufficient immobilization.^[12] As a result, we prefer rigid fixation with a plate osteosynthesis which provides superior fracture stability and excellent clinical results in the treatment of acute fractures and nonunions. In our study, the majority of complications were post-operative wound disorder (10%). Literature review shows infection rate up to 10% for plate fixation of displaced midshaft fracture.^[10,14] The other major complication of our study was hardware irritation

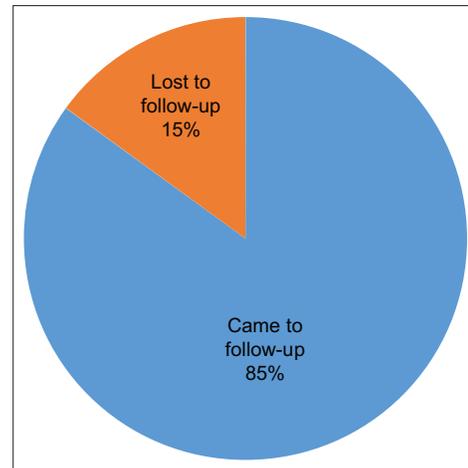


Figure 1: Patients follow-up

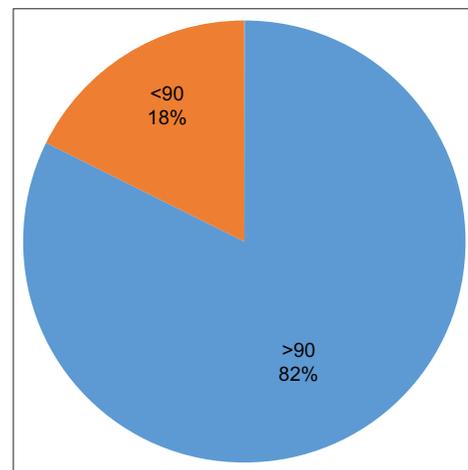


Figure 2: Constant shoulder scores

and prominence in 5% of patients. All cases were followed up regularly and no refractures were noted.

Taking these percentages into account, we believe that operative treatment of acute middle-third clavicle fractures should be reserved for persons who wish to return early to activity and who accept the risk for potential complications. Especially wound disorders and infection may lead to disasters and the patient should be duly informed before deciding to have the operation.

CONCLUSION

The traditional view that most clavicular fractures heal with good functional outcomes following non-operative treatment is no longer valid. Recent studies have identified a higher rate of non-union, late neurovascular compromise, and specific deficits of shoulder function in subgroups of patients with these injuries treated by conservative

means. Internal fixation by plate osteosynthesis has the advantage of early pain resolution, early return of shoulder function, and potentially early return to work. However, the encountered complications in our study were similar to other recent studies. Clavicle fractures should therefore be viewed as a spectrum of injuries with diverse functional outcomes, each requiring careful assessment and individualized treatment. Plate osteosynthesis should be preferred to treat indicated middle-third clavicle fractures in inactive individuals.

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