

A Prospective Outcome Assessment of Clavicle Fractures Treated with Open Reduction and Internal Fixation Utilizing Plate and Screws

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Abstract

Aim: To assess the functional result of clavicle fractures treated with open reduction and internal fixation utilizing plate and screws.

Method and Materials: This study was conducted in the department of Orthopaedics, NMCH, Patna, Bihar, India. The total number of cases included in the study was 60. Patients with age more than 18 years and less than 65 years and Fracture displacement more than 2 cm were included in this study. A detailed clinical history and evaluation including routine blood investigations and proper radiographic evidence with X – Ray of chest with bilateral shoulder AP view and 45-degree-cephalic tilt view of the involved side was done. Allman classification was used to classify clavicle fractures. Allman Classification-Group I- middle 1/3, Group II – lateral 1/3 (acromial) and Group III – medial 1/3 (sternal).

Result: A prospective review of experience with clavicle fracture fixation was performed. 60 clavicle fracture fixations using locking compression plate (LCP) and recon plate were performed for patients with fresh fractures over a period of 18 months. The patients (40 men and 20 women) ranged in age from 18 to 60 years (mean age of 39). 34 patients were reported to have right clavicle fracture while the remaining 26 cases were of left clavicle fracture. The most common mode of traumas recorded in our study were road traffic accident (28 cases), fall from height (24 cases), followed by fall from standing height (7 cases). Sports injury was reported as the cause of trauma in one patient. All patients satisfying surgical intervention indications underwent open reduction and internal fixation (ORIF) procedure. After evaluation of the type/site of injury it was determined that 15 patients had displaced medial-third clavicle fractures providing enough indication for intervention. Fixation using recon plate was approved for 12 patients while the remaining 3 patients of this group were cleared for fixation using locking compression plate (LCP).

Conclusion: Internal fixation of these fractures contributes to preservation and restoration of the anatomy while providing stability through implant fixation like locking compression plate (LCP) and recon plate. Plates and screws are favored because of the increased stability they provided and incidence of vascular trauma during surgery is very rare due to minimal contact between the plate and cortical bone. Surgical intervention also helps in speedy recovery with early pain resolution, early union, good ROM, decreased incidence of complications and satisfactory cosmetic results. We observed a reduced rate of complications in our patients (13%). Minor complications were identified and treated during follow-up resulting in complete recovery.

Keywords: Clavicle Fractures, Internal Fixation Locking Compression Plate, Recon Plate.

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Introduction

Clavicle fractures are a common orthopedic injury, accounting for approximately 2-5% of all fractures in adults and up to 10% in the pediatric population. These fractures typically occur due to direct trauma, such as falls, sports injuries, or motor vehicle accidents, and are classified based on their location along the clavicle: medial, middle, or lateral third. Management strategies for clavicle fractures have evolved, with surgical intervention increasingly

favored for displaced fractures to achieve anatomical reduction and promote faster recovery. [1] Open reduction and internal fixation (ORIF) using plates and screws have become a standard surgical approach, especially for fractures with significant displacement or comminution. The choice of ORIF with plates and screws is guided by several factors, including fracture type, displacement, patient age, and functional demands.

Plates and screws provide stable fixation, allowing early mobilization and reducing the risk of nonunion or malunion compared to non-surgical methods. [2,3] This approach is particularly beneficial in restoring the biomechanical integrity of the clavicle and facilitating optimal healing. During ORIF, the surgical procedure involves exposing the fractured clavicle through an incision, reducing the displaced fragments to their anatomical position, and securing them with plates and screws placed along the length of the bone. The choice of plate (e.g., reconstruction plates or locking compression plates) depends on fracture characteristics and surgeon preference, aiming to achieve rigid fixation while minimizing soft tissue disruption.⁴ Clinical outcomes following ORIF with plates and screws for clavicle fractures have generally been favorable. Studies have reported high rates of union, restoration of shoulder function, and patient satisfaction. Early mobilization facilitated by stable fixation has been associated with quicker return to activities of daily living and reduced rates of complications such as nonunion or hardware failure. Despite its advantages, ORIF using plates and screws is not without risks. Common complications include hardware irritation, superficial infections, and less frequently, nerve injury or vascular compromise. Careful patient selection, meticulous surgical technique, and postoperative management are essential to minimize these risks and optimize outcomes. [5]

Method and Materials

This study was conducted in the department of Orthopaedics, NMCH, Patna, Bihar, India for 12 months. The total number of cases included in the study was 60. Patients with age more than 18 years and less than 65 years and Fracture displacement more than 2 cm were included in this study. Patients with age less than 18 years or more than 65 years, Pathological fracture and Previous or concomitant lesion of the ipsilateral shoulder were excluded from the study.

Methodology

A detailed clinical history and evaluation including routine blood investigations and proper radiographic evidence with X – Ray of chest with bilateral shoulder AP view and 45-degree-cephalic tilt view of the involved side was done. Allman classification was used to classify clavicle fractures.

Allman Classification-Group I- middle 1/3, Group II – lateral 1/3 (acromial) and Group III – medial 1/3 (sternal)

A significant revision of the Allman classification was made by Neer. Group II (distal clavicle) fractures were further divided into 3 types based on the location of the clavicle fracture in relation to the coraco-clavicular ligaments.

Type I fractures - Minimally displaced and occur lateral to an intact coraco-clavicular ligament complex; these fractures may be treated non-operatively and symptomatically. Type II fractures – Occur when the medial fragment is separated from the coraco-clavicular ligament complex; the medial fragment is displaced cephalic by the pull of the sternocleidomastoid muscle, and the distal fragment is displaced caudally by the weight of the upper extremity, with the intact coraco-clavicular ligament complex; the resulting deformity leads to marked displacement of the fracture ends, predisposing this fracture type to a higher prevalence (upto 30%) of non- union. Type III injuries – Minimally displaced or non- displaced and extended into the acromioclavicular joint (AC); as with type I fractures, these injuries can be treated symptomatically; the development of the late AC degenerative changes can be treated with distal clavicular excision After necessary evaluations a decision to operate was taken. In all the cases, one hour before the skin incision, a prophylactic preoperative intravenous antibiotic was administered. In a modular operating theater, under strict aseptic precautions, under anesthesia the operative procedures were performed. A curvilinear incision was made over the clavicle, centered over the fracture site. Dissection done in layers, fracture site exposed and edges freshened. The reduction of the fracture was done and confirmed under fluoroscopic guidance. Based on the fracture configuration, either superior plating or anterior plating was done using a dynamic compression plate or a recon plate to fix the fracture. All patients were put on standard arm-sling for comfort. The patients were administered intravenous antibiotics post-operatively for 3 to 5 days. Gentle pendulum exercises started from post-op day 2. Sutures were removed on post-op day 12. Patient was followed up at regular intervals until 24 weeks. Sling was continued until radiographic evidence of healing was seen after which the patient was allowed for unrestricted range of motion exercises but not resistance and exercises or sports activities. Once radiographic union was observed, resistance and strengthening activities were begun. Quick DASH score was used to evaluate the results of the treatment.

Result

A prospective review of experience with clavicle fracture fixation was performed. 60 clavicle fracture fixations using locking compression plate (LCP) and recon plate were performed for patients with fresh fractures over a period of 18 months. The patients (40 men and 20 women) ranged in age from 18 to 60 years (mean age of 39). 34 patients were reported to have right clavicle fracture while the remaining 26 cases were of left clavicle fracture. The most common mode of traumas recorded in our study

were road traffic accident (28 cases), fall from height (24 cases), followed by fall from standing height (7 cases). Sports injury was reported as the cause of trauma in one patient. All patients satisfying surgical intervention indications underwent open reduction and internal fixation (ORIF) procedure. After evaluation of the type/site of injury it was determined that 15 patients had displaced medial-third clavicle fractures providing enough indication for intervention. Fixation using recon plate was approved for 12 patients while the remaining 3 patients of this group were cleared for fixation using locking compression plate (LCP). 10 patients having middle-third clavicle fractures were identified upon evaluation and segregated in a different group. Further evaluation revealed complications such as skin tenting indicating the necessity of intervention and repair. 8 patients of this group were identified and cleared for fixation using locking compression plate (LCP) while the remaining 2 patients were treated using recon plate. The remaining 35 patients were observed to have lateral 1/3rd clavicle fractures and upon evaluation provided enough evidence of complications to

require intervention and repair. 28 fractures of this group were treated with locking compression plate while the remaining 7 fractures were repaired using recon plate. A final review of the patients included in our study reported that 48 fractures were treated with locking compression plate (LCP) and 12 fractures were repaired using recon plate. The duration of hospital stay was reported to be 4-12 days (avg. 6.43 days). All patients were available for follow-up appointments at 1, 2, 3 and 6 months. Clinical and radiological evaluation indicated that the time to union in our patients ranged from 8-16 weeks (avg. 12.5 weeks). The average Quick-Dash score of our patients recorded at 12 and 24 weeks was reported to be 4.25 and 1.70 respectively. 8 of our patients reported complications in the periodic follow-up. Superficial infections observed in 2 patients were treated with oral antibiotics for 1 week leading to full recovery. Hardware irritation was reported in 3 patients. Signs of scar hypertrophy were observed in 2 cases. Shoulder stiffness was recorded in 1 patient which due to non-compliance of rehabilitation protocol.

Table 1: Patient Demographics and Fracture Characteristics

Parameter	Value
Total Number of Patients	60
Gender Distribution	40 men, 20 women
Age Range	18 to 60 years
Mean Age	39 years
Fracture Side	Right: 34, Left: 26
Mode of Trauma	Road Traffic Accident: 28 Fall from Height: 24 Fall from Standing Height: 7 Sports Injury: 1

Table 2: Types of Clavicle Fractures and Surgical Interventions

Clavicle Fracture Location	Type of Fracture	Number of Cases	Intervention Method
Medial-Third	Displaced	15	Recon Plate: 12 LCP: 3
Middle-Third	-	10	LCP: 8 Recon Plate: 2
Lateral 1/3rd	-	35	LCP: 28 Recon Plate: 7

Table 3: Treatment Outcomes and Complications

Outcome Parameter	Value
Type of Fixation	LCP: 48 Recon Plate: 12
Hospital Stay (days)	Range: 4-12 days Average: 6.43 days
Follow-up Appointments	1, 2, 3, and 6 months
Time to Union	Range: 8-16 weeks Average: 12.5 weeks
Quick-Dash Score	12 weeks: 4.25 24 weeks: 1.70
Complications	Superficial Infections: 2 Hardware Irritation: 3 Scar Hypertrophy: 2 Shoulder Stiffness: 1

Discussion

With emergence of refined surgical options and techniques, the management of clavicle fractures has evolved well in the past decade. A personalized treatment that best suits individual patients' activity level is required to gain satisfactory outcomes in cases of mid-shaft clavicle fractures. Irrespective of segment involved; hand to sling immobilization has

time and again proven to be the best possible treatment for non-displaced fractures. Conservative management has been the most popular choice of management of clavicle fractures in India regardless of comminution and displacement. However, many cases of non-union (15%) have been reported in the literature.⁵ It is reported that problems such as mal-union, decreased ROM of shoulder and lower

satisfactory rate (1/3rd not satisfied) following conservative treatment have made it a less favorable option these days. Studies also describe the wide acceptance of surgical intervention and repair procedures owing to their increased success rates and decreased incidence of malunion as well as non-union complications (only 2.2%). [6] Hence, our study primarily focuses on assessment and evaluation of union and functional outcomes post surgical intervention/fixation to treat clavicle fractures. Majority of patients in our study were males(66%) which makes it comparable to Wun-Jer Shen et al. (1999) [7] as well as other similar studies which similarly highlight that the incidence in males is twice as common as in females. H.Jiang et al(2012) reports mean time to radiographic union at 12.5 weeks which is comparable radiographic union at 12.5 weeks (post-op). In our study, the mean Quick-Dash score, measured at the end of 6 months, is found to be 1,7 which is in accordance with the finding of a similar study conducted by CM Robinson et al. We have observed hardware problems in 3 patients which amounts to 5% of the total cases included in our study. The hardware problems encountered can be because the clavicle is a subcutaneous bone with less soft tissue envelope over the implanted hardware contributing to implant-related complications. [8] Major complications such as neuro-vascular damage, implant leakage, skin necrosis, deep infections or adhesive capsulitis of the shoulder were not seen in our patients. [9,10] ROM of shoulder was near normal in all our patients post-procedure. The author suggests that it is vital for the surgeon to have a good understanding of the clavicle anatomy and surrounding structures. It is required to employ only those techniques that take into account the anatomy of the clavicle: notably vascularization and acromioclavicular ligament integrity and location of the fracture. It is also important to understand that the plate osteosynthesis should be based on the bone diameter and 3D curvature to avoid post-op complications. Although iatrogenic vascular complications are rare, a good knowledge of vessel relations and variants, especially in the medial end of the clavicle and midshaft improve the procedure outcomes to an extended degree.

Conclusion

Clavicle fractures have since long been considered as self-limiting injuries mostly treated conservatively. But in the past decade several studies have challenged this claim and according to popular belief surgical intervention to repair comminuted/displaced or complicated clavicle fractures has become widely accepted because of the low incidence in complications and aesthetic disfigurement. Reports of mal-union, non-union and chronic shoulder pain following conservative treatment has contributed to the inclination towards

surgical fixation using plates and screws. Internal fixation of these fractures contributes to preservation and restoration of the anatomy while providing stability through implant fixation like locking compression plate (LCP) and recon plate. Plates and screws are favored because of the increased stability they provided and incidence of vascular trauma during surgery is very rare due to minimal contact between the plate and cortical bone. Surgical intervention also helps in speedy recovery with early pain resolution, early union, good ROM, decreased incidence of complications and satisfactory cosmetic results. We observed a reduced rate of complications in our patients (13%). Minor complications were identified and treated during follow-up resulting in complete recovery. Hence from our study we can conclude that it is a safe and welcoming alternative to conservative treatment with reduced risk of complications.

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