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A clinical study on role of surgical management of clavicle fractures in adults

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Abstract
Introduction: Current literature has clearly shown that the indications for surgical treatment of clavicle fractures in adults are expanding. Although clavicle fractures in children and adolescents have traditionally been treated non-operatively, surgical treatment of displaced clavicle fractures may be indicated in adults.
Results: Excellent outcomes and rapid return to work can be achieved with surgical management of displaced clavicle fractures in the adults with high functional demands, similar to those of their adult counterparts. Complications include hardware irritation, screw loosening, pin migration, peri-incisional numbness, and refracture. Athletes and families must be counseled regarding complications and potential need for secondary surgery to remove hardware.
Conclusion: The patients with a displaced, shortened, or comminuted clavicle fracture presents a unique, controversial dilemma for the surgeon. Earlier return to work, can be achieved with surgical management to restore length and alignment and may prevent malunion, nonunion, and poor outcomes.

Keywords: LCP: Locking Compression plate, DCP: Dynamic compression plate, GA: General Anaesthesia, #: Fracture.

Introduction
Clavicle is the bony link from thorax to shoulder girdle and contributes to movements at shoulder girdle. Clavicle fracture is acommon traumatic injury around shoulder girdle due to their subcutaneous position. It is caused by either low-energy or high-energy impact. Fracture of the clavicle accounts for approximately 5 to 10% of all fractures and upto 44% of injuries to the shoulder girdle. About 70%to 80% of these fractures are in the middle third of the bone and less often in the lateral third (12% to 15%) and medial third (5% to 8%).Fractures of the clavicle have been traditionally treated non-operatively. Although many methods of closed reduction have been described, it is recognized that reduction is practically impossible to maintain and a certain amount of deformity and disability is expected in adults. In the past few years several publications have described about poor outcomes like malunion and non-union (15%) after conservative treatment of severely displaced clavicular fractures. In established cases of non-union of middle third clavicle fracture open reduction and internal fixation with bone grafting were contemplated with i) intramedullary devices like Steinmann pins, Hagie pins, Kirschner wires, Knowles pin and Rush rods. In this method rotational instability was noted and immobilization for longer period was required. Complications like loosening and breakage of pins were common. ii) Plate and screws fixation with semitubular plate, dynamic compression plate and reconstruction plate were used to get rigid fixation. For lateral third clavicular fracture operative treatments include transacromial Kirschner wire, cancellous compression screw and coracoclavicular screw. AO/ASIF group has recommended the use of tension band wire construct for fixation of displaced lateral third clavicle fracture. The clavicle is the most commonly fractured bone in children and accounts for 10% to 15% of all fractures in children. The majority occur in the midshaft region, and the most common mechanism of injury is a fall onto the point of the shoulder. The clavicle, which forms by intramembranous ossification, is invested by thick periosteum in children that can limit the displacement of fractures. Although the clavicle's medial physis is the last to close in the body at approximately 25 years of age, McGraw *et al*. have shown that 80% of the clavicle's growth

is completed by age 9 in girls and age 12 in boys, which has implications for remodeling potential in adolescents.

Aims and Objectives

1. To study the role of surgical treatment in fresh clavicular fractures.
2. To study the duration of union.
3. To study the complications of surgery.

Methodology

The present study was carried out from April 2016 to July 2020 at Orthopaedics Department of orthopaedics, Siddhartha Medical college, T begur, Harsha hospital, RR medical college and few other places, Bangalore. During this period 50 patients of clavicle fractures were treated surgically. Inclusion criteria: Adult male and female patients above 18 years who require surgical intervention for clavicle fractures were included for this study after taking written consent from them. Exclusion criteria: Patients less than 18 years of age, Patients not willing for surgery and Patients medically unfit for surgery. General information like name, age, sex, occupation and address were noted. Then a detailed history was elicited regarding mode of injury like fall on the shoulder, Road traffic accident, direct injury to shoulder and fall on outstretched hand. Enquiry was made to note site of pain and swelling over the affected clavicle. Past medical illness and family history were also recorded. General condition of the patients was examined for pallor, pulse rate and blood pressure. Respiratory and cardio vascular system were examined for any abnormalities. Consent for surgery taken then proceeded. Post-operative care: Patients were kept nil orally for 4 to 6 hours post-operatively. Intravenous fluids were given as needed. Antibiotics were continued for 10 days. Analgesics and tranquilizers were given according to the needs of the patient. The operated upper limb was immobilized in an arm pouch. Check x-rays were taken to study the alignment of fracture fragments. The wound was inspected at 3 or 4th postoperative day. Suture removal was done on 10th postoperative day. Patients were discharged with the arm pouch. Rehabilitation of the affected arm was started at the end of 2 weeks. Gentle pendulum exercises to the shoulder in the arm pouch were allowed. At 4 to 6 weeks gentle active range of motion of the shoulder was allowed but abduction in limited to 80 degrees. At 6 to 8 weeks active range of motion in all planes were allowed. Follow up: Regular follow up for every 4 weeks was done. Local examination of the affected clavicle for tenderness, instability deformity and shoulder movements were assessed. X-rays were taken at each follow up visits to known about progressive fracture union and implant position. Rehabilitation of the affected extremity were done according to the stage of fracture union and time duration from day of surgery. Patients were followed up till radiological union occur. The functional outcome were assessed by Constant and Murley9score.

Result

The present study consists of 50 patients of fresh fracture of the clavicle which were treated surgically with plate and screw for middle third clavicle fracture and Kirschner wire with tension band wire for lateral third clavicle fracture between April 2016 to July 2020 at Orthopaedics Department of orthopaedics, Siddhartha Medical college, T begur, Harsha hospital, RR medical college and few other places, Bangalore.. Following observation are made in our study. In this present study there were 40 patients (80%) of middle third clavicle fracture and 10 patients (20%) were lateral third clavicle fracture and there were no medial third clavicle fracture. All the patients in both middle and lateral third clavicle fracture were closed type. There were no associated medical illness in any patient. In middle third clavicle fractures direct injury occurred in 37 patients among them 13 patients were due to fall on shoulder from two wheeler, 23 patients were due to road traffic accident, 1 patient were due to fall on shoulder after simple fall. In direct injury occurred in 1 patient due to fall on outstretched hand and in 1 patient injury occurred by hitting train while crossing track. In lateral third clavicle fractures direct injury occurred in all 10 patients, among them 2 patients were due to fall on shoulder from height, and 8 patients due to road traffic accident. Majority of the patients with middle third clavicle fracture i.e.15 patients (30%) were in the age group of 19-29. The youngest patient was 19 years and oldest patient was 63 years. The average patient was 35.65 years. Most patients 3 cases (7.5%) with lateral third clavicle fracture was between 30-39 years. The youngest patient was 27 years and oldest patient was 57 years with average age of 37.5 years. In middle third clavicle fracture majority were males, 28 patients (70%) and females were 4 patients (10%). In lateral third clavicle fracture majority were males, 6 patients (15%) and females Were 2 patients(5%).In this study for middle third clavicle fractures there were 18 patients (45%) of right sided and 14 patients (35) of left sided fracture. For lateral third clavicle fracture there were 4 patients (10%) on left side and 4 patients (10%) on the right side. In middle third clavicle fracture 8 patients (20%) had associated injuries among them 2 patient (5%) had scapular body fracture and 2patient (5%) had rib fracture 1 patient had ipsilateral ulna shaft fracture and 1 patient had distal radius fracture and 1 patient had glenoid fossa fracture and 1 patient had brachial plexeus injury

Duration of Union

The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb was possible. In middle third clavicle fracture 28 patients united at the end of 12 weeks. In 4patients delayed union occurred. It was due to large butterfly fragment at fracture site which united at 16 weeks. In lateral third 7 patients united at the end of 12 weeks. In 1 patient (treated with hook plate) united at the end of 14 weeks. We advise the patient for removal of the plate at the end of 1 year. For 6 patients implant removal done. Remaining patient has not turned up for implant removal.

Complications

In our study like any other surgical procedure was found. Some are major and some minor. In middle third clavicle fixation 4 patients had hypertrophic skin scar and in 7 patients plate prominence occurred. In 2 patients restriction of shoulder movements occurred. In 4 patients delayed union occurred. In 1 patient plate loosening occurred which went for malunion and in 1 patient plate breakage occurred. In 1 patient superficial infection occurred which was treated with oral antibiotics for 5 days and in another 2 patient restriction of shoulder movements occurred due to associated glenoid fossa fracture. The patient was not able to follow the shoulder exercises because of pain. In 1 patient delayed union occurred. The functional outcome is assessed by constant and murley score. In this study on 32 patients with middle third clavicle fracture treated with plate and screws 24 patients had

excellent functional outcome, good functional outcome in 6 patients and fair functional outcome in 2 patient. For 8 patients of lateral third clavicle fracture fixed with Kirschner wire and tension band wire 4 patients had excellent functional outcome results and 2patients had good functional outcome 1 patient had fair functional outcome and with 1 patient fixed with 4 hole hook plate had fair functional outcome due to associated scapula body fracture.

Discussion

Clavicle fractures are usually treated conservatively. In a study conducted to analyze the results of conservative treatment by Hill *et al*, Nordqvist *et al.* 2andRobinson *et al.* found poor results following conservative treatment of displaced middle third clavicle fracture. Conservative treatment of displaced lateral third clavicle fracture has higher rate of non-union and residual shoulder dysfunction as showed by Edwards *et al*4.In this present study middle third clavicle fracture patients with Robinson Type-2 B2 (Displaced with simple or butterfly fragment) were more common and there were 20 patients (50%). Type-2 B1 (displaced with comminution) occurred in 12 patients (30%).In Bostman *et al.* 5study also Robinson type-2B1 was common in 81 patients (78.64%). Robinson type-2 B2 occurred only in 22 patients (21.36%).In lateral third clavicle fracture patients with Robinson Type-3 B1 (Displaced With extra articular) were more common and there were 6 patients (15%). Type-3 B2 (displaced with intra articular) occurred in 2 patients (5%).In Kao *et al.* 6series also all the 12 patients belong to Robinson type-3 B1 (Neers type-II).In this study the middle third clavicle fractures were fixed with reconstruction plate in 6 patients (15%). Locking compression plate in 20 patients (50%) and dynamic compression plates in 6 patients (15%).Locking compression plate was used commonly because precontoured to the shape of the clavicle and provide stable fixation. This in comparison with Bostman *et al.* 5. study were reconstruction plates were used in 46 patients (44.66%). Dynamic compression plates were used in 55 patients (53.40%) and semi tubular plates in 2 patients (1.94%). In the initial period of his study dynamic compression plates were used then in later part of his study reconstruction plates were used. Later found there was no difference in the complication rate between the patients treated by dynamic compression plate and reconstruction plate. In this study majority of the middle third clavicle fracture 28 patients united at the end of 12 weeks. In 4patients delayed union occurred. It was due to large butterfly fragment at fracture site which united at 16 weeks. There were no non-union. Lazarus MD stated radiological union occurred approximately between 6 to 12 weeks. In lateral third 7 patients united at the end of 12 weeks. In 1 patient (treated with 4 whole dynamic compression plate) united at the end of 16 weeks. In Kao *et al.* 6series union occurred after an average period of 4 months. Bostman series had similar union period like our study.

Conclusion

- Clavicle fractures are usually treated conservatively but there are specific indications for which operative treatment is needed like comminuted, displaced middle third clavicle fractures and displaced lateral third clavicle fracture.
- Among the internal fixation methods intramedullary fixation do not control rotation so they require longer period of immobilization till union.
- In this study primary open reduction and internal fixation with plate and screws of fresh middle third clavicle fractures provides a more rigid fixation and does not require immobilization for longer periods.
- In this study locking compression plates were used as it is provides strong fixation due to locking between the screw and plate, and blood supply preservation due to minimal contact between plate and cortical bone and precontured to the shape of the clavicle, side specific and provide stable fixation. It is necessary to put the plate superiorly and at least three screws to be applied medially and three screws laterally.
- Semitubular plates were not used because it was difficult to contour and less stress resistant.
- Dynamic compression plate is strong but it gives excessive prominence through the skin and it is difficult to contour.
- All the fractures united and there was no non-union.
- Implant removal were advisable for all the cases after union.
- For displaced lateral third clavicle fractures in a small study of patients, fixed with Kirschner wire with tension band wiring and with 4 whole hook plate early mobilization gave excellent results.

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