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Comparative study of Non-operative versus Operative treatment for middle 1/3rd clavicle fracture

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Abstract

Background: A fracture of the clavicle has been greatly underrated in respect to pain and disability. Clavicle is the bony link from thorax to shoulder girdle and contributes to movements at shoulder girdle. Clavicle fracture is a common traumatic injury around shoulder girdle due to its subcutaneous position. It is caused by either low-energy or high-energy impact about 69 to 82% of these fractures are in the middle third of bone and less often in the lateral third (12% to 15%) and medial third (5% to 8%). Prompt fixation of these clavicle fractures permits increased patient comfort and early shoulder mobility. The proponents of early fixation of fresh clavicular fractures to prevent complications like malunion and nonunion emphasize the value of accurate reduction and rigid fixation in affording quick pain relief and promoting early functional recovery.

Material and methods: Thirty patients were taken into the study and were divided into operative (O) and conservative (C) category. Approval from ethical committee was taken with written informed consent by the patient. The outcome was evaluated clinically radiologically for union, complications, cosmesis and functional scoring by Constant and Murley score.

Observation and Result: Out of 30 patients, 18 were treated conservatively, Among them good anatomical results were found in 13 patients (72.22%), poor results were found in 5 patients (27.78%). 12 patients were treated surgically, Among them good anatomical results were found in 11 patients (91.67%) and poor were found in 1 patient (8.33%). patients were treated conservatively and had excellent functional outcome (27.78%) in 5 patients, good functional outcome (55.56%) in 10 patients, and fair functional outcome (16.67%) in 3 patients. 12 patients were treated surgically with precontoured clavicle plate and had excellent functional outcome (91.67%) in 11 patients and fair functional outcome (8.33%) in 1 patients. Out of 30 patients, 4 patients (22.22%) of displaced middle third clavicle fractures which were treated conservatively had developed malunion, 1 patient (5.56%) had developed delayed union and no non-union was reported. In 12 patients which were treated surgically with precontoured plate, 1 patient (8.33%) was reported with hardware irritation and 1 patient (8.33%) was reported with implant failure. The average union time is longer in conservatively treated patients (12.33) weeks as compared to operative group i.e; (8.67) weeks.

Conclusion: primary open reduction and internal fixation with precontoured clavicle plate for displaced, comminuted middle third clavicle fractures provides a more rigid fixation and allows early mobilization higher functional outcome compared with conservative treatment which require longer periods of immobilization till fracture union. Simple, undisplaced fractures can be treated with conservative treatment which gives good results in terms of functional and anatomical aspects but when this method is used for displaced, comminuted fractures it gives complications such as malunion and non-union.

Keywords: clavicle fracture, Robinson classification, middle 1/3rd fracture, operative, non-operative, conservative treatment, clavicular plate

Introduction

A fracture of the clavicle has been greatly underrated in respect to pain and disability. The “usual or routine treatment” is perhaps far short of satisfying relieving therapy—Carter R. Rowe, 1968.

Clavicle is the bony link from thorax to shoulder girdle and contributes to movements at shoulder girdle. Clavicle fracture is a common traumatic injury around shoulder girdle due to its subcutaneous position. It is caused by either low-energy or high-energy impact. About 69 to 82% of total clavicle fractures are in the middle third of bone and less often in the lateral third (12% to 15%) and medial third (5% to 8%) [10].

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. [10] In the past few years several publications have described about poor outcomes like mal-union and non-union (15%) after conservative treatment of severely displaced clavicular fractures [23].

Prompt fixation of these clavicle fractures permits increased patient comfort and early shoulder mobility. The proponents of early fixation of fresh clavicular fractures to prevent complications like mal-union and non-union emphasize the value of accurate reduction and rigid fixation in affording quick pain relief and promoting early functional recovery [45].

Fracture Biomechanics

For middle shaft clavicle fractures the displacing forces are:-

1. Superior displacement of medial segment-sternocleidomastoid [18].
2. Inferior displacement of lateral segment-pectoralis major and Latissimus muscles.
3. Trapezius provides a stabilizing force against inferior displacement of the lateral segment.

Management of Middle One Third Clavicle Fractures

In the 1960s, Neer [38] and Rowe [52] each reported operative management had higher non-union rates (4.6% and 3.7%, respectively) when compared with non-operative management (0.1% and 0.8%, respectively). A recent meta-analysis revealed higher non-union rates in displaced mid-shaft clavicle fractures treated non-operatively (15%) than operatively (2.2%) with modern internal fixation techniques [67]. Thus treatment should be so planned as to encourage early union with restoring the anatomical functional integrity of the shoulder.

Aims and objectives

To assess the outcomes of operative and non-operative management of middle 1/3rd clavicle fracture in the form of union and mean time to union, residual deformity, functional outcome as per Constant and Murley score, complications.

Material & methods

Clinical Materials

This study was conducted at our institution from July 2011 to July 2013. During this period 30 cases of adult patients with middle one-third clavicle fractures who are skeletally matured having no contraindication to surgery were selected to the inclusion criteria and excluded those with pathological fractures.

The fractures were classified according to Robinson's classification. Type 2 (mid shaft clavicle fractures) cases were included in our studies. Type 1 and type 3 cases were mainly excluded because of involvement of medial and lateral shaft involvement.

In this study, Broad arm sling used for conservative treatment and Pre-contoured clavicle plate used for surgical treatment. Other plates (Reconstruction plates, semi-tubular plates, dynamic compression plates) and intramedullary devices like Knowles pins, threaded k-wires, Hagie pins were not used, due to their high failure rates because these implants does not provide rigid fixation and thus immobilization needed for longer duration. There is always a greater risk of migration and loosening of pins inside bone. Intramedullary fixation does not have control over the rotational forces produced by

shoulder movements. Cases were followed at regular intervals. This study was conducted with due emphasis for clinical observation and analysis of result after conservatively and surgical management of mid shaft clavicle fractures.

Inclusion criteria

- a) Skeletally mature male and female patients
- b) Middle 1/3rd fracture clavicle
- c) Compound fractures
- d) No ipsilateral upper limb fracture

Exclusion criteria

- a) Skeletally immature patients
- b) Pathological fractures
- c) Any fracture other than middle 1/3rd fractures

Management of Patients

At the arrival of the patient with suspected clavicle fracture patients were resuscitated depending upon their general condition. Simple sling or broad arm sling was given to stabilize fracture.

The distal neurovascular status of the affected upper limb was examined and also the associated injuries along with fractured clavicle were noted.

Plain radiograph of clavicle with shoulder in antero-posterior view was taken to assess the site of fracture and the fracture type (displacement and comminution). The fracture was classified according to Robinson's classification. The affected upper limb was immobilized in an arm pouch.

Investigations

- Routine blood examination for Hb %, TLC, ESR, Blood Group.
- Routine Urine examination – Protiens, Sugar and Microscopic examination.
- Blood Urea, Serum Creatinine, RBS.
- HIV I & II, HbsAg, ECG.
- Echocardiography as when needed.
- X – Rays:
- Clavicle full length with shoulder AP view in sitting or standing position.
- Chest PA view.

All the patients were shifted to ward and simple sling or broad arm sling was applied (depending upon the built of the patient), analgesics were given accordingly. Patients were evaluated for associated medical problems and reference was taken from respected departments and necessary treatment was started, associated injuries were evaluated and accordingly all patients were counselled about their respective modalities of treatment on the basis of their fracture pattern as evident on radiographs.

On the basis of indications of open reduction and internal fixation of middle one third clavicle fractures we sorted the patients which needed operative treatment (twelve patients) whereas the remaining ones were treated conservatively (eighteen patients).

Preoperative Preparation of Patient

- Patients were kept fasting for 6 hours before surgery.
- A written informed consent for surgery was taken.
- The neck, chest, axilla shoulders and arm were prepared.
- Tranquilizers were given as advised by the anaesthetist.
- A systemic antibiotics usually inj. Taxim 1gm intravenously were administered 30 minutes before

surgery to all patients.

- All patients were operated under general anaesthesia.

Instruments Used For Pre-Contoured Plate Fixation

- 3.9mm pre-contoured clavicle plate
- 2.8mm drill bit
- 3.5mm universal drill guide
- Hand drill/pneumatic drill
- 4.0mm Tap for cortical screw
- Depth gauge
- 2.7mm/3.5mm/4.0mm cortical screw of varying sizes (12-22mm)
- Hexagonal screw driver.
- General instruments like retractor, periosteal elevator, reduction clamps and bone lever.

Technique

Patient Positioning

The patient is placed in supine position. A bolster is placed between the shoulder blades to help facilitate reduction of the fracture during the case. The patient's involved upper extremity is prepped and draped in a sterile fashion

Exposure

Approximately a six cm transverse (medial to lateral) incision is made over the palpable fracture of the clavicle, usually in the middle third. The medial fragment is usually proximal in relation to the distal fragment. Dissection is carried down to the fascia and the skin flaps are elevated. The cutaneous nerves are protected. The musculature is then sub-periosteally elevated off the bone fragments. It is important to keep soft tissue attachments to the butterfly fragments in an attempt to maintain vascularity. The fracture is reduced.

Plate Selection

The appropriately sized left or right clavicle plate is selected of the different length and curvature. The two middle slots may be placed over the fracture, ideally leaving two to three locking and/or non-locking holes.

Plate Placement

Once the plate's ideal positioning has been selected, it is provisionally stabilized to the clavicle with bone clamps. The non-locking screws may be placed either uni-cortical or bi-cortical.

Final Plate and Screw Position

An intraoperative radiograph is recommended to check the position of the screws and the final reduction of the fracture. If the surgeon feels the bone quality of the lateral fragment is poor, sutures may be passed from medial to lateral around the coracoid process and the plate to take stress off of the lateral fixation. The musculature is then re-approximated directly over the plate. The skin is then closed in layers with a sub-cuticular stitch for the remaining skin layer.

Post-operative antibiotics were continued for 2 days. Analgesics and tranquilizers were given according to the needs of the patient. The operated upper limb was immobilized in broad arm sling. Check x-rays were taken to study the alignment of fracture fragments. The wound was inspected at 3rd or 4th postoperative day. Suture removal was done on 10th postoperative day. Patients were discharged with the broad arm sling. Rehabilitation of the affected arm was started at the end of 2 weeks. Gentle pendulum exercises

to the shoulder in the sling were allowed. Follow-up 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. The functional outcome were assessed by Constant and Murley score [42, 43].

Observations and results

Majority of the patients i.e.17 patients (56.67%) were in the age group of 21-40 years. The youngest patient was 19 years and oldest patient was 75 years. The average patient age was 37.10 years.

Out of 30 patients, 21 patients were male (70%) and 9 patients were female (30%).

In this study Robinson classification was followed. There were no type-1 (medial third) and type-3 (lateral third) fracture included. In type-2 middle third fracture type 2A1 (undisplaced) occurred in 13 patients (43.33%), type-2 B1 (displaced with simple or single butterfly fragment) occurred in 15 patients (50%) and type-2B2 (displaced with comminuted or segmental) fracture occurred in 2 patients (6.67%).

The functional outcome is assessed by Constant and Murley score. In this study 30 patients of middle third clavicle fractures treated both conservatively as well as surgically. Among them 18 patients were treated conservatively and had excellent functional outcome (27.78%) in 5 patients, good functional outcome (55.56%) in 10 patients, and fair functional outcome (16.67%) in 3 patients.

Out of 30 patients, 4 patients (22.22%) of displaced middle third clavicle fractures which were treated conservatively had developed malunion, 1 patient (5.56%) had developed delayed union and no non-union was reported. In 12 patients which were treated surgically with precontoured plate, 1 patient (8.33%) was reported with hardware irritation and 1 patient (8.33%) was reported with implant failure.

In this study fracture mostly united between 8-12 weeks in 24 patients (80%) and in 6 patients (20%) union occurred after 12 weeks. In 18 conservatively treated patients, 13 patients (72.22%) showed union between 8-12 weeks and 5 patients (27.78%) showed union after 12 weeks. In 12 surgically treated patients, 11 patients (91.67%) showed union between 8-12 weeks and 1 patient (8.33%) showed union at 16 week due to implant failure.



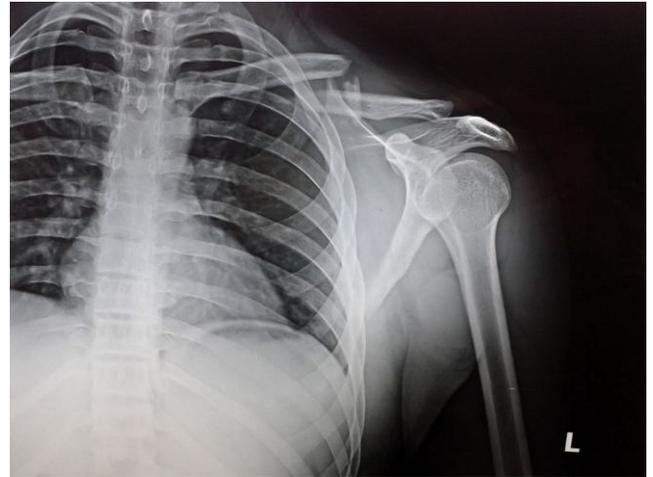
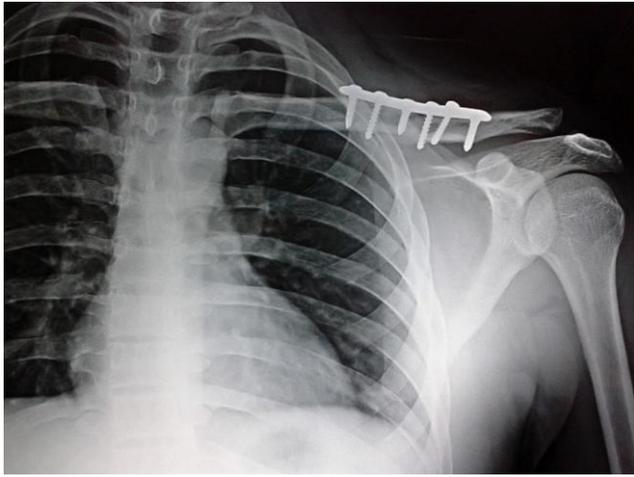


Table 1: Robinson classification

Type	Non-Operative		Operative		Overall	
	Frequency	%	Frequency	%	Frequency	%
2A1	13	72.22	0	0.00	13	43.33
2B1	5	27.78	10	83.33	15	50.00
2B2	0	0.00	2	16.67	2	6.67
Total	18	100.00	12	100.00	30	100.00

Table 2: Anatomical outcome

Anatomical	Non-Operative		Operative	
	Frequency	%	Frequency	%
Good	13	72.22	11	91.67
Poor	5	27.78	1	8.33
Total	18	100.00	12	100.00

Table 3: Constant and Murley score

Shoulder Rom	Non-Operative		Operative	
	Frequency	%	Frequency	%
Excellent	5	27.78	11	91.67
Good	10	55.56	0	0.00
Fair	3	16.67	1	8.33
Total	18	100.00	12	100.00

Table 4: Complications

Complications	Non-Operative		Operative	
	Frequency	%	Frequency	%
Malunion	4	22.22	0	0.00
Delayed Union	1	5.56	0	0.00
Non-Union	0	0.00	0	0.00
Hardware Irritation	0	0.00	1	8.33
Implant Failure	0	0.00	1	8.33
Nil	13	72.22	10	83.33
Total	18	100.00	12	100.00

Table 5: Union time

Union (Weeks)	Non-Operative		Operative		Overall	
	Frequency	%	Frequency	%	Frequency	%
08-12	13	72.22	11	91.67	24	80.00
<12(13-18)	5	27.78	1	8.33	6	20.00
Total	18	100.00	12	100.00	30	100.00
08-12	13	72.22	11	91.67	24	80.00

Discussion

Fractures of the clavicle are common, accounting for 5 to 10% of all fractures and up to 44% of all injuries to the shoulder girdle [38, 47]. About 80% of these fractures occur in the middle third of the clavicle [38, 51, 52]. Traditionally these fractures have been treated conservatively. Neer in 1960

suggested that only 0.1% of fractures treated non-operatively, will fail to unite [38]. More recently, however, it has been suggested mid shaft fractures with 20 mm initial shortening have a 15% non-union rate [19]. Symptomatic mal-union of clavicle fractures can also occur in 31% to 50% of cases [19, 31]. Reasons for dissatisfaction include weakness, pain,

displacement, or a bump [31]. Other indications for clavicle fixation include open fractures, skin compromise, neurovascular damage, floating shoulder and symptomatic non-unions [24, 30, 45].

In this study there were 13 patients (43.33%) fracture type 2A1, 15 patients (50%) type-2 B1 and 2 patients (6.67%) type-2B2 according to Robinson classification. The average duration of union is longer in conservatively treated patients (12.33) weeks as compared to operative group i.e. (8.67) weeks. 24 patients (80%) showed radiological union between 8 to 12 weeks and 6 patients (20%) showed union after 12 weeks. In Canadian orthopaedics trauma society [7] series the radiological union time after conservative treatment was 28 weeks and in operative treatment was 16 weeks. In Daniel J. Brown *et al.* [12] series the average union time was 12.8 weeks after plate fixation.

In conservative group, four patients of displaced middle third clavicle fractures had developed symptomatic mal-union (22.22%), one patient had developed delayed union (5.56%). In operative group, one patient was reported with hardware irritation (8.33%) and one patient was reported with implant failure (8.33%). The complication rate in conservative management (27.78%) was higher as compared to operative management (16.66%). We found no non-union in either conservative or surgically treated patients which is compared with following series.

Conclusion

Based on our experience and results, we conclude that primary open reduction and internal fixation with pre-contoured clavicle plate for displaced, comminuted middle third clavicle fractures provides a more rigid fixation and allows early mobilization whereas conservative treatment require longer periods of immobilization till fracture union. Simple, undisplaced fractures can be treated with conservative treatment which gives good results in terms of functional and anatomical aspects but when this method is used for displaced, comminuted fractures it gives complications such as mal-union and non-union.

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