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Orthopaedics

MANAGEMENT OF DISPLACED MIDDLE THIRD CLAVICULAR FRACTURES WITH SUPERIOR RECONSTRUCTION PLATING

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Abstract:

Background: The management of clavicle fractures is inclining towards fixation for displaced middle-third clavicle fractures as the conservative treatment gives poor results. There was no evidence to suggest that early operative treatment of displaced clavicular shaft fractures showed a functional benefit when compared with the results of initial non-operative treatment till now. However, recent studies show displaced clavicle fractures was associated with greater risk of non-union, poor clinical outcome, and decrease in shoulder strength.

Materials and methods: Various methods have been described for operative fixation of clavicular shaft fractures, implants including extramedullary semi tubular plates, reconstruction plates, Dynamic Compression Plate(DCP), Limited Contact Dynamic Compression Plate (LCDCP), locking plates, intramedullary fixation with Knowle's pins, Haige pins, Rockwood pins and titanium nails.

Results: Intramedullary fixation of clavicle, though more cosmetic is technically more demanding owing to lack of clear cut medullary canal and higher complication rates upto 75%. Plate fixation provides immediate rigid stabilization, pain relief, facilitates early mobilisation and return to pre injury activities. Superior placement of plate is biomechanically more stable especially in presence of inferior cortical comminution. So, Open Reduction and Internal Fixation (ORIF) with superior reconstruction plating was preferred in adults with displaced middle third clavicle fracture and

those having tenting skin. The aim of this study is to evaluate the functional outcome of midshaft clavicular fracture in adults managed with ORIF with superior reconstruction plating.

Conclusion: The traditional method of managing middle third clavicular fracture conservatively gives poor functional results. Intramedullary fixation is not favoured for its higher complication rate though better cosmesis. Reconstruction plates can be contoured according to the need and superior placement with six cortical purchases on either side gives stable construct, predictable union and optimum functional outcome. Use of bone Interfragmentary screws should be done carefully as might cause further comminution and primary bone graft might be justified in comminuted fractures. Owing to the subcutaneous anatomy of clavicle, superior implantation of implant might cause hardware prominence especially in lean individuals demanding subsequent removal. Site specific precontoured locking plates in recent use are yet to be fully tested in comparative clinical studies.

Key words: clavicle, conservative management, plating, recon plate.

Introduction

The clavicle or collarbone is the only long bone in the body that lies horizontally. Clavicle fractures are common injuries in active individuals, especially those who participate in activities where collisions are common (e.g, road traffic accident [RTA], sports). In the axial projection, the clavicle is noted to have both medial and lateral flat expanses, linked by a thin, tubular middle. This central transitional area represents a weak link in clavicular structure. The mid clavicle, therefore, is the most common site of fracture.¹⁻⁴ It is becoming increasingly apparent that clavicular malunion is a distinct clinical entity with radiographic, orthopaedic, neurologic, and cosmetic features. Increasing reports of complications associated with non-operative management like symptomatic malunion, non-union, shortening, droopy shoulder, have stirred towards operative management of clavicle fractures. Internal fixation restores the anatomical continuity of the clavicle, early return to functional activity, the shorter period of immobilization, and less complications.⁵⁻¹⁰ Hence, the present study was conducted to analyse the outcome of managements of non-operative and operative procedures in fracture clavicle. A number of such studies have been undertaken for the western population, but studies in Indian setup are less.

Patients And Methods

Twenty patients with displaced

middle third clavicle fracture who underwent open reduction and internal fixation with reconstruction plating in MediCiti institute of medical sciences, ghanpur during the period from August 2014 to august 2016 were prospectively followed. Elderly patients, skeletally immature and patients with open fracture, pathological fracture, associated ipsilateral multiple fracture were excluded.

Inclusion criteria

Patients aged above 15 years with fracture of the clavicle.

Exclusion criteria

Patients with pathological fractures, open fractures, fractures associated neurovascular injury with objective neurological findings on physical examination, associated head injury, and medical contraindication to surgery and/or anaesthesia.

The patients were subjected to proper history taking and clinical examination. Clinical examination was done to assess the skin condition over the clavicle, swelling, abnormal prominence, distal neurovascular status of the involved side upper limb. Examination of the head, neck, chest, abdomen, spine and the other limbs was done to rule out associated injuries. After stabilizing the patient, the girdle was immobilized in clavicle brace (CB)/modified figure of eight (MFO8) bandage/strappings and sling. Routine investigations were done. The clinical diagnosis was confirmed by the antero-posterior radiograph of the chest showing both clavicles. In this study, injuries were classified according to the AO classification scheme.

The clavicle fractures were further divided into the medial metaphyseal, diaphyseal and lateral metaphyseal fractures. After proper preanesthetic check-up of the operative group patients, surgery was performed

Surgical Technique

Anesthesia General anesthesia was given to all operative group patients, and the endotracheal tube is taped to the normal side. Patient positioning and preparation: The patients were positioned in a beach-chair semi-sitting position\modified beach-chair position. The involved shoulder was prepared and draped. The arm was usually padded and strapped to the patient's side except in lateral one-third clavicle fractures where the arm was free draped.

A curved incision was given over the superior aspect of clavicle. Supraclavicular nerve was identified and attempted to preserve. The fracture site was exposed and utmost respect was paid to avoid excess periosteal stripping. Reduction was done and fracture was stabilized by contoured 3.5 mm reconstruction plate placed superiorly with at least 3 cortical purchases on each side. Interfragmentary screw and bone graft was done as and when required. Closure was made in two layers. The limb was supported with arm pouch post operatively.

Post Operative Protocol

Wound dressing was done on second day and patient discharged home on second or third post operative day if the wound was satisfactory. On two weeks follow up, the sutures was removed and check x-ray done. Patient was advised for gentle pendulum exercise only. Next follow up was

done in six weeks, where repeat X-ray was done and full range of motion of shoulder started. Subsequent follow up was done in three months, six months and one year. In one year follow up, the patients were counselled about implant removal and final functional outcome was evaluated using Constant score and patient's satisfaction

Results

There were 20 patients, 16 males and 4 females. The mean age of the patients was 31.5 years with SD 11.5 years (range 15-60 years). Eleven fractures occurred on the right and nine on the left side, nine resulting from fall from height, 10 due to RTA and one due to assault.

According to Edinburg system, 12 were type 2A2, five were 2B1 and three were 2B2 fracture. Five fractures had tenting skin and none had open fracture, associated neurovascular injury or scapula-thoracic dissociation.

Five patients (25%) had associated injuries, three had rib fracture and one had metacarpal and remaining one had tibia fracture and fracture of multiple phalanges of foot. Associated injuries besides rib fracture were managed in the same operative setting. Reconstruction plate (3.5mm) ranging from six to ten holes was used and contoured as necessary. Interfragmentary screw was applied in four cases and primary bone graft was done in two cases. The average hospital stay was 3-9 days. None of the patients had early wound infection. One patient had deep infection in 5 months follow up and the implant was removed. However the fracture had already united and the infection was only in the screw holes. Careful curettage was done and was treated as chronic osteomyelitis. One patient developed frozen shoulder in three

months follow up where Manipulation under anaesthesia (MUA) was done in four months and put under extensive physiotherapy. Subsequent follow up was unremarkable.

All the fractures had united in near anatomic position on four months follow up. Implants were removed in five patients after one year, the most common indication being hardware prominence and young age. The average constant score was 97.45 with SD 3.1 in one year follow up. All the patients were relatively satisfied with the procedure. None of the patients had implant loosening, non union or implant failure.

Discussion

Fractures of the clavicle are common, accounting for 2.6% of all fractures, more than 75% located in the midshaft.¹¹

Many conservative treatment methods have been described, but simple arm sling or figures of 8 bandage have been widely used¹². Neither technique reduces the fracture, the outcomes were identical, but arm sling demonstrated better patient satisfaction.¹³ Moreover, figure of eight bandage was associated with higher complications like axillary pressure sore, neurovascular compression.¹⁴ Past studies have shown high level of patient satisfaction after non operative treatment of these fractures and even more operative treatment had higher rates of nonunion^{4,14-16}. However, recent studies have demonstrated higher rates of nonunion and poor functional outcomes after non-operative treatment, while the results of primary operative treatment have improved considerably.^{8,17,18}



Case 1 : (a) X-ray showing displaced clavicle fracture (b) Post operative X-ray (c) Full abduction at 1 year follow-up (d) Full ROM at 1 year follow up

The deforming force of sternocleidomastoid is very strong and cannot be overcome by external supports provided by arm sling or figure of eight bandage¹⁹.

Neer's nonunion rate of 1% is misleading as more recent studies

show higher rates of nonunion in displaced midshaft clavicle fracture treated conservatively¹⁴. A metaanalysis of recent studies reduced the risk of nonunion by 86% in the operative group compared to non operative group⁹. Drawbacks of conservative management can be effectively overcome by surgically treating these fractures achieving near normal anatomic, cosmetic and functional profile.^{8,17} Plate fixation provides immediate rigid stabilization, pain relief, facilitates early mobilisation and return to pre injury activities^{2,7,10}. Superior placement of plate is biomechanically more stable especially in presence of inferior cortical comminution, but associated with greater risk of injury to underlying neurovascular structures and subsequent prominence of plate may necessitate its removal.²⁰ Low complication rate was associated with inferior implantation of plate, although superior placement provided biomechanically more secure fixation. In our series also stability was preferred over cosmesis and fracture was fixed with superior implantation of reconstruction plate countering it as necessary. Neer and Rowe's higher rate of nonunion after operative fixation can be overcome by using 3.5 mm reconstruction plate with at least six cortical purchase on either side and delaying institution of physiotherapy programme.^{4,11} A recent multicentre trial comparing non operative treatment with primary plate fixation for displaced fractures in 138 patients demonstrated better functional outcomes, lower rates of malunion and nonunion, and a shorter time to union in the latter group.¹⁷ Constant score significantly improved in operative group and the mean time to radiographic union was 38.4 weeks

in non operative group compared with 16.4 weeks in operative group (p=0.001)^{29,17,21} In our series also, there was no malunion or nonunion, excellent function with average Constant score of 97 and all fractures united in 16 or less weeks. Clinical and radiographic signs of nonunion included mobility or pain on stressing of the fracture and an absence of bridging callus on radiographs. Interfragmentary screw provides compression at fracture site but should be applied carefully as it might cause more comminution. In our series, we applied such screws in 4 cases, but comminution occurred in two, so was avoided in latter cases. Primary bone graft may be indicated in comminuted fracture and was done in two type 2B2 fractures, which healed uneventfully.

Although the complication rate of 34% and a re-operation rate of 18% (most for hardware removal) are reported in operative group, in our series we encountered complications in two(10%) cases and five(25%) reoperations all for implant removal.¹⁷ The complications related to plate fixation are infection, plate failure, hypertrophic or dysaesthetic scars, implant loosening, non union, and rarely intraoperative vascular injury.^{5,22,23} In our series we encountered one deep infection requiring early implant removal and one frozen shoulder which recovered well after MUA and extensive physiotherapy. No early complications occurred after implant removal. Though it is important to preserve supraclavicular nerve during operation, none of our patients had any complaints even if it was sacrificed during operation.

Conclusion

The traditional method of managing middle third clavicular

fracture conservatively gives poor functional results. Intramedullary fixation is not favored for its higher complication rate though better cosmesis. Reconstruction plates can be contoured according to the need and superior placement with six cortical purchases on either side gives stable construct, predictable union and optimum functional outcome. Use of bone Interfragmentary screws should be done carefully as might cause further comminution and primary bone graft might be justified in comminuted fractures. Owing to the subcutaneous anatomy of clavicle, superior implantation of implant might cause hardware prominence especially in lean individuals demanding subsequent removal. Site specific precontoured locking plates in recent use are yet to be fully tested in comparative clinical studies.

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