Neglected volar barton fracture treated by two-stage procedure

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Abstract

Malunion following a neglected volar barton fracture can cause severe functional impairment owing to changes in normal anatomic and biomechanical relationships of the distal radius. These malunions, if mature can be treated by intra-articular osteotomies or the salvage procedures. But in nascent malunions, these procedures cannot be performed as the solid bony consolidation is absent and there is severe soft tissue contracture. In the present study, two-stage procedure was presented for the treatment of nascent neglected volar barton fracture presenting after 5 weeks, and treated primarily with gradual distraction and secondarily with open reduction and internal fixation with locked distal radius plate along with bone graft. Complete bony healing occurred in 6 months and Mayo wrist score improved from 31 to 85. At final follow-up after 2 years, visual and analog pain scores reduced from 68 to 11 and range of motion was 80° extension to 70° flexion along with near normal full grip strength along with mild wrist arthrosis. Surgical treatment of neglected fractures of distal radius can substantially improve wrist and hand functions, but rarely restores the limb to normal.

KEY WORDS: Neglected volar barton fracture, neglected distal radius fracture, intercarpal distraction, distal radius locking plate

Introduction

Fracture of the distal radius is one of the most common injuries, comprising 8–17% of fractures seen in the emergency department. Malunion is the most common complication following distal radius fracture, which can occur in approximately 23% non-surgical treated and in about 11% surgical treated patients.¹ The main cause of malunion is either improper treatment or delayed presentation. Owing to obvious revealing of fracture, gross pain and limitation of motion along with awareness and improvements in medical care, delayed presentation of volar barton fracture is extremely rare. Delayed presentation of these fractures particularly in developing countries are due to, primary treatment from bone setters/quacks/osteopaths, not seeking treatment at all, inability to identify re-displacement early, which is quiet frequent because of lack of regular follow-up. Other reason for neglect can also be acute life-saving medical condition, which took precedence over the treatment of distal radius fracture. Malunion following a neglected volar barton fracture can cause severe functional impairment.²³ In the present paper, a two-staged procedure for neglected volar barton fracture presenting after 5 weeks, primarily treated with gradual distraction and secondarily with locked distal radius plate along with bone graft was reported.

Case Report

A 28-year-old computer operator, with left hand dominance, presented with pain, deformity, and limitation of motion of left wrist joint after trauma, which occurred due to fall on outstretched hand around 5 weeks ago. It was primarily treated by bone-setter with massage.

Pain was severe to moderate, localized to volar aspect of wrist. There was rest pain which increased with activity leading to hamper the daily activity of the patient. Marked tenderness was present and wrist was volar subluxated, with typical dinner fork deformity at the wrist. Swelling or palpable mass around the wrist was absent. Grip strength was grossly decreased to 25% compared to normal side. Range of motion was painful and grossly restricted, with greatest loss in extension. Elbow and shoulder were normal. Allen test was negative.

Identifying re-displacement early is critical in such cases as it can significantly influence the outcome. The treatment of choice is surgical, which includes open reduction and internal fixation with locked distal radius plate along with bone graft. The majority of such cases are treated by bone-setters and after a few weeks, the patient presents to an orthopaedic surgeon. In such cases, the initial treatment is crucial as it can significantly influence the outcome. The treatment of choice is surgical, which includes open reduction and internal fixation with locked distal radius plate along with bone graft.
negative. There were no signs of complex regional pain syndrome or carpal tunnel syndrome.

Radiological examination of wrist showed old mal-uniting intra-articular fracture of distal end radius with gross volar subluxation of carpalis with proximal migration and intra-articular incongruity (Figure 1a,b).

Primarily, a radio-metacarpal and ulno-metacarpal distractor was applied under brachial block with aim to distract the fracture site. Two schanz pins were passed proximally in the middle third radius between brachioradialis and ECRB and two distally in the 2nd metacarpal, for radiocarpal distraction. Distractors assembly was connected and similarly ulno-metacarpal distractor also applied and the gradual distraction was started at 1 mm/day. Regular X-rays at each week were done to note the distraction. Initial distraction was seen at fracture site and at wrist, but after 2 weeks the inter-carpal distraction was noted. Noting this inter-carpal distraction, the gradual distraction was stopped (Figure 2).

After 1 week, distractor was removed and open reduction and internal fixation with distal radius locking plate and bone graft was done. In supine position with arm in the side table via volar approach under fluoroscopic guidance between palmaris longus and flexor carpi radialis the wrist was opened. The median nerve retracted medially and the pronator quadratus muscle cut in L fashion. Bony union was absent between the fractures and only fibrous union was present, which was curetted with removal of fibrous tissue to re-approximate the fracture line. A blunt probe was used to differentiate between hyaline cartilage and fibrous tissue. Joint was visualized through the fracture leaving the volar radiocarpal ligaments and wrist capsule intact. A 5-hole distal radius locking plate was applied after achieving the accurate reduction of the fragments and filling autogenous iliac cortico-cancellous bone grafts between the fragments. Since the distal fragment was very small and all the distal screws when viewed under fluoroscopy directed inside the joint, hence the distal fragment was only buttressed with the plate without passing any screws in the distal fragment. After through wash, the wound was closed in layers.

Wrist was immobilized in below elbow cast for 3 weeks after that gradual mobilization started and full ROM achieved at 6 weeks. Patient returned to employment at 6 weeks. Modified Mayo wrist score improved from 31 to 85 points by 6 months. At final follow-up after 2 years, visual and analog pain scores reduced from 68 to 11 and range of motion was 80° extension to 70° flexion along with near normal full grip strength. Radiological examination showed complete bone healing with incorporation of the graft along with the maintenance of all radiological parameters like palmar tilt, radial inclination, ulnar variation and radial length to near normal of 15°, 24°, 2 mm, and 1.3 cm, respectively. Although the patient had arthrosis of the wrist joint with subluxation of DRUJ, the patient is doing fine with no impairment in functional daily activity and without change of occupation (Figure 3). Informed consent is obtained from patient.

Discussion

Union with deformity or malunion is the most common complication of distal radius fracture. It can leads to alterations in normal anatomic and biomechanical relations of distal radius, incongruency at DRUJ and DRCJ with changes in volar tilt and ulnar variance, loss of relative length and rotational deformity, which can finally lead to change in load concentration, shift of forces to volar position, decreased ROM, ulnocarpal impingement, changing the carpal tunnel direction, angulations in the flexor tendons, decreasing the grip strength and leading to post-traumatic arthrosis and diminished function.

Malunion following neglected distal radius fracture can be a “nascent malunion” as in our case in which deformity is...
either a radiographic deformity that may or may not lead to functional limitation which is encountered during the time of fracture consolidation, prior to or shortly after cast removal, before sufficient period of exercise has passed to determine what functional limitations will be present due to bony deformity or a "mature malunion" in which there is functional limitation that may or may not be related to a radiographic deformity, which is encountered after a period of exercises has failed to resolve the functional limitation.3

Freshly presenting volar Barton fractures, i.e., within 3 weeks, are primarily treated with open reduction and internal fixation, since closed reduction is difficult to maintain and redisplacements and subluxation of carpals are frequent in cast. But in mature malunion, i.e., presenting after 6 weeks, the fracture is consolidated, bony union is achieved and original fracture line is difficult to recreate, hence the treatment of these malunions is intra-articular osteotomies particularly in young, active individuals or the salvage procedures (limited carpal arthrodesis, total wrist arthrodesis, proximal row carpectomy, wrist denervation, and wrist arthroplasty) for individual with severe cartilage degeneration, low functional demand and elderly.28 But gray zone exists regarding treatment of the nascent malunion which presents between 3 and 6 weeks, as in our case, in which exact guideline not described.

In nascent malunions presenting between 3 and 6 weeks, the callus in nascent and immature and original fracture can be identified, recreated after callus removal, hence these can be treated with osteosynthesis. But due to soft tissue contracture and proximal migration of the fracture fragment, it is difficult to bring the fractured segment distally and anatomically reduce the intra-articular fragment. Another option for treatment of nascent malunion, is to delay the intra-articular osteotomy till its conversion to mature malunion, which should not be done because performing the surgery earlier, prevents the maladaptive soft -tissue contracture and arthrosis.

In our case fracture was only 5 weeks old with nascent immature callus, without bony consolidation, we planned to perform osteosynthesis. But primary osteosynthesis alone was difficult to achieve in view of gross displacement, proximal migration and severe soft tissue contracture. Hence, the procedure was staged with primary gradual distraction with application of a radiocarpal and ulnocarpal distractor, followed by osteosynthesis by locked distal radius plate along with bone graft in second stage.

After initial successful distraction at fracture, inter-carpal distraction was noted following which, the distraction was stopped immediately. Hence we recommend regular serial follow ups with radiographs to anticipate this intercarpal over-distraction earlier and act accordingly because over-distraction has been implicated in producing stretching to tendons, worse digital motion, poor functional outcomes, and worse weakness and pain score.12,13 Although there is no threshold limit for distraction, but there is a correlation between increasing carpal height index and worse functional outcomes with distraction of 5–8 mm across the radiocarpal and midcarpal joints have no negative outcome.14

Further fixed angle locking distal radius plates have distinct advantage over conventional plates providing stability by fixed angle locking and supporting the subchondral bone and resisting the axial forces across the wrist that lead to settling and loss of reduction. Although our patient had arthrosis of the wrist joint and dorsal subluxation of distal ulna, but there was substantial improvement in the functional outcome with no pain and without impairment in daily activities and change of occupation.

Very few articles are available on neglected intra-articular fractures or malunions.8,15–17 But all these cases had mature malunions, which presented after 6 weeks when there was solid bony consolidation, which were amenable to intra-articular osteotomy.

Conclusion

In conclusion, surgical treatment of neglected fractures of distal radius can substantially improve wrist and hand functions, but rarely restores the limb to normal. Mature malunions are treated by intra-articular osteotomies or the salvage procedures. But in nascent malunion were the solid bony consolidation is absent, osteosynthesis can be attempted. It reduces the donor site morbidity, as the callus resected

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**Figure 3:** A 2-year-post-surgery follow-up AP (a) and lateral (b) X-rays and clinical photos (c and d).
during exposure and mobilization of the fracture can be used as bone graft, thereby avoiding need to operate on a second site and avoids complications related to osteotomy like non-union, osteonecrosis of distal fragment or instability in construct. The problem of difficulty in reduction, soft tissue contracture, tendon shortening can be overcome by initial gradual distraction avoiding need of con-committant tenotomy or Z lengthening of the flexor tendons.

References