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Functional outcome of distal end radius fractures managed using locking compression plates

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Abstract

In our study, 30 patients with unstable, displaced, comminuted, intra-articular fracture of distal radius were treated and followed up with open reduction and internal fixation using 2.4 mm anatomical locking plates in a tertiary care hospital from May 2012 to October 2014. Patient were evaluated with mayo score at 3 weeks, 3 months, 6 months and 1 year. At 1 year the mayo score suggest, 93.3% patients were pain free with only 6.33% patients having mild occasional pain and average mayo score for pain was 24.67, 53.33% patients have equal hand grip as compare to opposite side and average mayo score for hand grip was 20.83, 40% of patients has equal range of movements as compare to opposite side with remaining were between 75-99% of opposite side and average mayo score for range of movement was 22, 93.33% patients had returned to their pre-injury employment and average mayo score for their functional status was 24.67. We concluded that volar fixed angle plating is a effective means of treatment for comminuted, displaced, intra-articular distal radius fracture.

Keywords: distal, radius fractures, managed using, compression plates

Introduction

Distal radius fractures have an approximate incidence of 1:10,000 people and represent 16% of all fractures and 74% of forearm fractures managed by orthopaedic surgeons¹. Incidence is increasing in all groups but sharpest increase is seen in both elderly females and young males^[2-4]. This represent two different injuries: Insufficiency fractures in elderly patients and traumatic injury in young males. The most common trauma mechanism is falling over the outstretched hand^[1]. Injury in younger adults is more equally between the sexes^[5]. Essentially, we know that elderly patients will accept more displacement (and closed treatment) than younger patients, but some still have poor outcomes. Interestingly, despite the development of a malunion, many elderly patients function relatively well, but the majority of studies showing acceptable function involved elderly patients who were frail or had low functional demands^[6]. Madhok *et al.* noted that in elderly patients treated non-operatively 26% reported functional impairment^[7].

The management of distal radius has undergone extraordinary evolution over two centuries since Colle's proclamation in 1814, from universal cast treatment to pinning to bridging external fixator to buttress plating to dorsal locking plates to advanced palmar locking plates. Recent studies are concluding that functional outcome parallels to restoration of normal anatomy. Fernandez, Trumble and others have reported that as little as 1mm of incongruity of the articular surface with worse outcomes^[8], whereas other reports have found no association between radiographic arthrosis and functional outcome. The optimal management requires an accurate restoration of skeletal anatomy by closed or open treatment, prompt recognition and repair of concomitant injuries and rehabilitation supervised by highly skilled therapists.

Treatment of comminuted, displaced intra-articular and potentially unstable fractures with open reduction and internal fixation with locking compression plates improves the functional outcome by achieving anatomical reduction of articular surface and alignment of dorsal and palmar cortex. If the opposite cortex is comminuted, the surface could collapse because of both axial forces across the wrist joint and toggle of the screws in the conventional plates due to poor cortical purchase of screws, which may result in loosening of the distal screws^[9]. Plates with locking distal screws or pegs support the subchondral bone and resist forces across the

articulation that may displace the articular fragments [19]. This new fixation technique of using locking compression plates shows promise in terms of stable intraoperative fixation and restoration of acceptable anatomy resulting in early mobilisation, excellent functional outcome and decreased morbidity. The purpose of study is to determine outcome of patients managed with open reduction and internal fixation using locking compression plates.

Materials and Methods

In this clinical study 30 patients with unstable, displaced, comminuted, intra-articular fracture of distal radius were treated and followed up with open reduction and internal fixation using 2.4 mm anatomical locking plates in a tertiary care hospital from May 2012 to October 2014. Ethics committee approval and informed written consent was obtained from the patient prior to the initiation of study. Patients of both the genders in the age group 18 to 60 years with an intra-articular distal end radius fracture were included in this study. Patients with open, pathological and malunited fractures were excluded.

Patients were admitted in ward, detailed history was taken regarding mode of injury, duration of injury, dominance, occupation, past history of trauma, associated injuries and any medical or surgical illness. In all patients below elbow splint was applied and limb elevation was given with the aim of relieving pain and swelling. Oral or parenteral analgesics and anti-inflammatory were given as per tolerability. Routine blood investigations and radiographs were obtained. Computerised tomographic scan of wrist with 3 dimension reconstruction with digital subtraction of carpus to show displacement of articular fragments. Post-operative radiographs with wrist AP in 10 degrees elevation and lateral in 20 degrees elevation to visualise the articular surface. A.O. classification was used for classification of fractures. Apart from the A.O. classification, radiographic analysis including an assessment of the articular comminution and an extension of fracture into diaphysis was done. All patients were evaluated with respective investigations and treated by respective speciality for associated medical or surgical illness. Patients were operated on elective basis after pre-anesthetic check up, carried out one day prior to surgery after taking a written informed consent regarding surgical procedure and associated risks. Open reduction and internal fixation with volar fixed angle locking plates using Modified Henry's approach [10]. 2.4 mm fixed angle volar locking plates with/out supplementation with k-wires. Post operatively, the limb was kept in below elbow splint and limb elevation for next one week. Active finger movements and elbow range of motion exercises were started. Suction drain was removed after 48 hrs. Sutures were removed after 10-14 days and patient was put in below elbow cast for 3 weeks. Active and passive range of motion exercises were started after cast removal after 3 weeks [11-13]

Patient were evaluated with mayo score at 3 weeks, 3 months, 6 months and 1 year which includes:

- Pain with visual analogue scale.
- Hand grip with hand dynamometer.
- Range of movement with goniometer.
- Functional status.

Data analysed statistically by using P test (paired t test). It is used as the number of candidates are <35 in each group [14].

Results

Out of the total patients, 22 were male (73.33%) and 8 females (26.67%). The average age of study population is 39.43yrs with range from 22 to 72 yrs. In our study, the most common cause of DER fracture in patients is found to be due to RTA (36.66%) followed by trivial fall and fall from height i.e. 30% each and others corresponds to 3.33%. At three weeks, one patient was pain free, 30% patients had mild occasional pain and average mayo score for pain was 16.83, 20% patients had >50% of hand grip as compared to opposite side and average mayo score for hand grip was 3.67. 26.67% of patients has >40% range of movements as compare to opposite side and average mayo score for range of movement was 6.83. 33.33% patients had returned to their employment but restricted it and average mayo score for their functional status was 13.

At 3 months the mayo score had improved with 33.3% patients were pain free with 63.3% patients having mild occasional pain and average mayo score for pain was 21.5. Four patients had equal hand grip as compare to opposite side and average mayo score for hand grip was 12.33. 30% of patients had >75% range of movements as compared to opposite side and average mayo score for range of movement was 16.67. 43.33% patients had returned to their pre-injury employment and average mayo score for their functional status was 21.33.

At 6 months the mayo score has further improved with 73.3% patients were pain free. The remaining patients having mild occasional pain and average mayo score for pain was 23.67. Fourty percent patients had equal hand grip as compared to opposite side and average mayo score for hand grip was 17.83. 23.33% of patients had equal range of movements as compared to opposite side. 73.33% patients had returned to their pre-injury employment and average mayo score for their functional status was 23.5.

At 1 year the mayo score suggested that 93.3% patients were pain free with only 6.33% patients having mild occasional pain and average mayo score for pain was 24.67. 53.33% patients had equal hand grip as compared to opposite side and average mayo score for hand grip was 20.83. 40% of patients had equal range of movements as compared to opposite side and remaining were between 75-99% of opposite side and average mayo score for range of movement was 22. 93.33% patients had returned to their pre-injury employment and average mayo score for their functional status was 24.67.

With increasing age patient takes more time to recover. Chances of recovery are better for Young people followed by Middle age people and lastly for Old age people. Only one patient had reported with complication of median nerve compression neuropathy and presented with paresthesia in the sensory distribution of median nerve with no motor involvement. The plate removal was done after fracture healing and median nerve was released from fibrous tissue around it. Rest no other complication as tendon injury, infection, arthritis we encountered.

Discussion

Distal end radius fractures are the most common fracture (Approximate 20%) [7] encountered by orthopaedic surgeons in emergency. Middle age and elderly population have intra-articular fracture corresponding to fall from height and associated osteopenia. Since decades it is a matter of extensive debate that which method of fixation of distal radius fracture is best. Management of patients aim at early rehabilitation of these patients and return back to their pre-

injury status with avoiding complications like finger and wrist stiffness, infections, tendon and nerve injuries. Most of the distal radius fractures in young and middle age population are displaced, comminuted, intra-articular and unstable type. Fixation with low profile 2.4 mm anatomical locking plates is best modality in high energy fractures, osteopenic fractures^[15]. External fixation devices result in finger stiffness, superficial radial nerve injury, pin tract infections associated with increase in morbidity and prolong rehabilitation^[16]. Poor mechanical properties of osteopenic bones, severe metaphyseal comminution leads to increase incidence of collapse, as seen in patients managed with casting or k wire fixation technique^[7, 17]. In such fractures only bone stock available for fixation is often the immediate subchondral bone distally and the diaphysis proximally. Volar fixed angle plate systems provide fixation for such fractures by attaining subarticular fixed angle support in distal subchondral bone¹⁵. Locking screws or pegs support the subchondral bone without relying on the purchase of the screws in the bone as in case of conventional plates which results in toggle of screws and loss of reduction on transmission of axial forces^[19].

Volar plating is a commonly performed procedure in our hospital for intra-articular distal radius fractures in all age groups. Pre-operative assessment with adequate X rays and CT Scan is necessary to visualise the degree of comminution and displacement of fragments. Careful approach with dissection to preserve neurovascular structures and intra-articular fluoroscopy is of utmost important to determine the reduction and stability of radial length, volar and radial tilt. Post operatively all patients were given below elbow splint for 3 weeks and mobilisation of finger and elbow started after 48 hours when the pain was in tolerable limits. All patients were followed up at 3 weeks, 3 months, 6 months and 1 year and assessed for loss of reduction by respective X rays and clinically by measuring range of motion and hand grip. Pain and occupational status was subjectively assessed.

In this study 30 patients were assessed, out of which 22 were male (73.33%) and 8 females (26.67%). 60% patients were of young age group out of which 56% and 39% had excellent and good outcome respectively. 33% patients were of middle age group of which 60% and 40% had excellent and good outcome and only 7% were elderly population with 50% had good and 50% satisfactory outcome. This signifies that distal radius fracture is more common in male than female and more in younger age group related to level of activity in this age group. Younger population had more favourable functional outcome than older population at end of 1 year which is been indicated by 'P' test and also correlates with the observation of Letsch R1 and Krappinger D.

In our study, 40% of patients sustained type B fracture (partial articular) of which 67% having excellent and 25% have good outcome at 1 year. Sixty percent of patients sustained type C fracture (complete articular) of which 44% having excellent and 39% have good outcome at the end of 1 year indicate that severity of fracture affects the outcome which correlates with findings of Jakim II, Pieterse HS, Sweet MB¹³³. But, 'P' test does not indicate any significant increase in score from 6 month to 1 year.

27% patients were operated within 5 days of injury of which 75% had excellent and 25% have good outcome at 1 year. 40% patients were operated between 5-10 days of injury of which 27% had excellent, 47% had good and 26% had satisfactory outcome at 1 year. 33% patients were operated after 10 days of injury of which 86% had excellent and 14% have good outcome at 1 year, suggest that if the patient gets

operated within 5 days or more than 10 days then outcome is better than if surgery is performed between 5-10 days most probably due to swelling and inflammation which is significant between 5-10 days.

93% patients returned to their pre-injury employment after 1 year.

Only one patient had complication with median nerve compressive symptoms for which implant removal and neurolysis was done.

With the above inferences it can be concluded that volar fixed angle plating is a effective means of treatment for comminuted, displaced, intra-articular distal radius fracture with minimal complication as seen with other techniques of pin plaster and external fixator application, preventing loss of reduction and resulting excellent long term functional outcome. Functional outcome is also affected by age, severity of injury and interval between day of injury and surgery performed.

Fallacies in this study does not indicate significance between severity of injury and outcome so further study randomised trial with more number of patients is required for it. Late outcomes as secondary arthritis is not determined as patients were followed up only till 1 year. As per this study volar plating with fixed angle plates cannot be marked as treatment of choice as it is not a comparative study with functional outcome of patients managed with other modalities of treatment.

Conclusion

Distal end radius fractures are increasingly prevalent in younger age group most commonly due to high energy trauma which is usually type B and C as per OTA classification (displaced, comminuted, intra-articular fracture). Excellent functional outcome in these patients requires restoration and maintainance of articular congruity of radiocarpal and radioulnar joints. Functional outcome depends upon patient's age, fracture anatomy, displacement, reducibility, stability, duration between day of trauma and surgery and articular incongruity of fractures. Functional results are related more to the quality of anatomical reduction achieved than to the fixation technique. Volar locking compression plating is a safe and effective treatment for unstable fractures of the distal radius especially in high energy trauma and osteopenic bones which has insufficient bone to provide purchase to screws of conventional plates and metaphyseal bone loss. It can also stabilize dorsally displaced fractures with avoiding complications of dorsal plating. As per above analysis excellent results at the end of 1 year were found in 53% patients. 93% patients returned to their pre-injury employment after 1 year. Hence we concluded that open reduction internal fixation with volar fixed angle plate is an effective, acceptable and preferable method of treating displaced, comminuted, intra-articular distal radius fractures in view of minimal complications as compare to other modalities of treatment which shows prolonged recovery due to complications.

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