Distal radius fractures managed by penning dynamic wrist fixator

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Summary: There are several operative options are available for distal radius fractures. External fixation is also an effective option for distal radius intra-articular fractures.

Objective: To evaluate the results of distal radius fractures with the use of local made penning wrist fixator.

Material & Methods: Patients with unstable distal radius fractures were managed with “Penning Dynamic Wrist Fixator” from September 2008 to August 2011. The inclusion criteria was based on the Müller AO-classification C with their subtypes, C1, C2 and C3, which correspond to Fernandez classification Type 3 and 5. The functional assessment was done using the criteria of Gartland & Werley described in 1951. This system is based on a demerit point system, which involves an objective evaluation of wrist function. The fixator was applied to the 2nd and 3rd metacarpals and middle & distal 3rd of the radius. The ball joint was aligned with the axis of the wrist, applied over the pins and then locked. Ligamentotaxis was done for indirect reduction of fracture fragments.

All cases were followed with postoperative radiographs and clinical assessment. Then followed through OPD weekly and then twice monthly when discharged from hospital otherwise thrice weekly radiographs. Fixator was removed after achieving union & after removal of fixator below elbow plaster cast was applied for 02 to 03 weeks.

Results: We managed 22 distal radius fractures were and stabilized with penning dynamic wrist fixator. Age ranged from 25 – 45 years, average was 35 years, with 16 left and 06 right-sided fracture involvement. There were 14 females and 08 male. Fall on out stretched hand 17 (77.27%), sports injury and fall from height and Road Traffic Accidents 5 (22.72%). Out of 22, 08 patients had Muller type C1, 05 C2 and 09 were C3. The fixator removed in the clinic at 10 weeks. All fractures united within 8 weeks. According to Gartland & Werley assessment System our patients’ score was, Excellent 6 (27.2%), Good 12 (54.5%), Fair 03 (13.6%) and Poor 1 (4.54%). The average time of follow up was 20.2 weeks with a range of (10–72 weeks).

Conclusion: Penning Dynamic wrist fixator demonstrates good outcomes with minimal risk in selected fracture patterns. This method can provide adequate fracture stability, and soft-tissue preservation. Patient may return rapidly to function as compared with other methods of treatment.

Key words: Radius fracture, distal, Penning Dynamic Wrist Fixator.

INTRODUCTION

External fixation has been used for the treatment of distal radius fractures for more than 50 years. Although the fixator configurations have undergone considerable modification over time, the type of fixator itself is not as important as the underlying principles that provide the foundation for external fixation. Although volar plate
fixation is currently in vogue, the indications for external fixation remain largely unchanged. Newer fixator designs have also expanded the traditional usage to include non-bridging applications that allow early wrist motion (David and Slutsky, 2007).

Some important anatomical points must bear in mind when considering external fixation of the distal radius. The articular surface of the radius is triangular, with the apex of the triangle at the radial styloid. It slopes in a volar and ulnar direction with a radial inclination of 23° (range 13 TO 30°), a radial length of 12 mm (range 8 TO 18 mm), and an average volar tilt of 12° (1–21°) (Feipel et al., 1998).

External fixation of distal radius fractures can be used in a bridging or non-bridging manner. Bridging external fixation of distal radius fractures typically relies on ligamentotaxis to both obtain and maintain reduction of the fracture fragments. An longitudinal traction is applied to the carpus, the tension is transmitted mostly through the radioscaphocapitate and long radiolunate ligaments to restore the radial length (Woo et al., 1981).

A gradual loss of the initial distraction force applied to the fracture site through stress relaxation (Winemaker et al., 1998). The immediate improvement in radial height, inclination, and volar tilt are significantly decreased by the time of fixator removal (Sun et al., 2001).

The biomechanical requirements of external fixation for fractures of the distal radius have not been ascertained because, until recently, the magnitude and direction of the physiologic loads on the distal radius were dynamic and unknown. Recent work by Rikli et al., however, has shed new light on this point (Rikli et al., 2007).

The strength of the fixator depends on the rigidity of the connecting rods and the clamps. Many external fixator rods are 0.5 to 1.0 cm in diameter. Most distal radius external fixators use 3.0 or 4.0 mm threaded half pins. A bicortically-inserted pin with a short thread will provide the best pin–bone fixation.

In order to achieve stable fixation and reduce the lever arm of displacing forces, the pins should be inserted close to the fracture site. One pin is hence inserted close to the fracture site, while the second is placed as far away as possible (Behrens et al., 1983).

Increasing the rigidity of the fixator does not appreciably increase the rigidity of fixation of the individual fracture fragments (Wolfe et al., 1999).

There are a number of ways, however, in which to augment the stability of the construct. After restoration of radial length and alignment by the external fixator, percutaneous pin fixation can lock in the radial styloid buttress and support the lunate fossa fragment (Seitz et al., 1991).

K-wire fixation enhances the stability of external fixation. The combination of an external fixator augmented with 1.6-mm (0.62 in) K-wires approaches the strength of a 3.5 mm dorsal AO plate (Dunning et al., 1999).

Objectives

To evaluate the results of distal radius fractures with the use of local made penning wrist fixator.

MATERIAL AND METHODS

Patients with unstable distal radius fractures were managed from September 2008 to August 2011 at Department of Orthopaedic Surgery & Traumatology, Liaquat University of Medical and Health Sciences, Jamshoro & Department of Orthopaedics, Irs University Hyderabad. This is retrospective evaluation of a series of patients treated with external fixation. The design of the study was quasi experimental.

The criteria for inclusion were based on the Orthopaedic Trauma Association adapts the Müller AO-classification C with their subtypes, C1, C2, and C3, which correspond to Fernandez classification (Fernandez et al., 2002) Type 3 and 5. Instability of distal radius fractures was defined as: (1) dorsal tilt >15 degrees, (2) volar tilt >20 degrees, (3) ulnar variance >4 mm, (4) radial inclination <10 degrees, (5) shortening >10mm, (6) displacement >100% loss of opposition (Leone et al., 2004).

All patients with distal radius fractures, either through casualty or through out patient department, selected according to inclusion criteria were treated with “Penning Dynamic Wrist Fixator”. The surgery was done within 48 hours after arrival and admission in the hospital. All cases were followed with immediate postoperative radiographs and clinical assessment. Then followed through OPD weekly and then twice monthly when discharged from hospital otherwise thrice weekly radiographs.

Fixator was removed after achieving union & after removal of fixator below elbow plaster cast was applied for 02 to 03 weeks and followed in review clinic from 06 to 12 weeks. Record of all the cases were maintained in the prosforma which include all the information regarding the patients' history, status of his/her general condition and fractures from the time of arrival to discharge. In all cases healing was assessed by radiological as well clinical examination and fractures were labeled united when the fracture line obliterated and not visible radiologically and no movement was seen clinically at fracture site.

The functional assessment was done using the criteria of Gartland&Werley described in 1951. This is one of the most commonly used outcome measures for evaluating wrist and hand function. This system is based on a demerit point system, which involves an objective evaluation of wrist function. It relies on the concept that a minimum of 45° dorsiflexion, 30° palmar flexion, 15° ulnar and radial deviation and 50° pronation and supination is normal. Demerit points are given based on the presence of a specific arbitrarily determined degree of loss of range
of movement. For example, five points are given for a 45° loss of dorsiflexion, and only one point is given for loss of palmar flexion of more than 30°. Depending on the number of points scored, the outcome is classified as excellent, good or poor.

Operative procedure

After complete pre-operative investigations & assessment by pre-anesthetic clinic, the patients were placed on operating table. Usually general anesthesia had been given to all patients. Forearm & hand was washed & draping of limb was done.

All the fractures were assessed, manipulated & reduced under image intensifier. The wrist was usually placed in moderate (manual) traction; flexion & radial abduction (i.e. ulnar deviation). The fixator was applied to the 2nd and 3rd metacarpals and middle & distal 3rd of the radius.

Pins were inserted in the frontal plane on the radial side so that the wrist immobilization may be implemented at a later stage if desired. The proximal metacarpal pins were inserted first close to the base of the bone on the flare of tubercle.

A stab incision was made & the soft tissues were dissected down to the bone, the center of which is located through the trocar. The trocar removed & 2.7mm drill bit were used & both cortices were drilled, 2.5 to 3.0 mm pins were used.

Same steps were repeated for the insertion of 2nd pin in the metacarpal & other two proximal pins in the radius. The ball joint was aligned with the axis of the wrist, applied over the pins and then locked. Ligamentotaxis was done for indirect reduction of fracture fragments.

One or two percutaneous supplemental K-wires were inserted to enhance the fracture reduction and increased the stability of the external fixator and also prevents the late collapse of fracture particularly in the unstable fractures >50% comminution. Reduction was assessed under image intensifier. Limb elevated for 24 hours to reduce the soft tissue edema. Meticulous attention was given to the pin tracks during post-op period. The patients were instructed to perform active movements of fingers and thumb.

RESULTS

We managed 22 distal radius fractures were treated and stabilized with penning dynamic wrist fixator. Age ranged from 25 to 45 years, average was 35 years, with 16 left and 06 right-sided fracture involvements. There were 14 females and 08 male.

They had been caused by fall on out stretched hand 17 (77.27%), sports injury and fall from height and Road Traffic Accidents 5 (22.72%). Out of 22, 08 patients had Muller type C1, 05 C2 and 09 were C3. All patients were managed under general anaesthesia. All distal radius fractures were compared with the uninjured contralateral side, with 41% excellent, 46% good, 10% fair and 3% poor results.

Out of 14 (63.6%) women studied, 06 (42.8%) suffered injury of right wrist and 08 (57.1%) of left wrist. Out of 08 (36.3%) men studied, 03 (37.5%) suffered injury of right wrist and 05 (62.5%) of left wrist.

Time lapse between injury & arrival to hospital was 1 hour to 95 hours (average time 35.7 hours). Average duration of stay in hospital was 28.9 hours. All patients were followed in out patient clinic and during each visit plain radiographs are taken. The fixator and pins removed in the clinic at 10 weeks if the radiograph shows fracture union. All fractures united within 8 weeks (Table 1).

The average time of follow up was 20.2 weeks with a range of (10 to 72 weeks). Wrist flexion and extension and forearm pronation and supination improved significantly over time, mainly between the 08 to 14 weeks evaluation. The grip strength improved from 10 to 22 weeks postoperatively by an average of 5 to 6 kg. Pin site infection was recorded in 9 patients and treated with antibiotics. No deep infections occurred.

DISCUSSION

External fixation provides good results, minimal reoperation and complication rate with minimal intervention of soft tissues. This method is not a new treatment option and was already recommended by Bohler in 1956 (Leung et al., 1987). External Fixation for fractures of the distal radius has been used for almost 80 years.

The main objective is to gain reduction and maintain the reduction throughout the treatment period. Several fixator concepts are available and selection is based on the complexity of the injury to be treated as well as the surgeon’s experience. External fixation of the distal radius has found its place as an established method in treating certain types of this common fracture (Gausepohl et al., 2000).

Cooney (1983) used transarticular external fixation without systematic use of bone grafting in 60 patients with an average age of 63 years. The average follow-up was 2.4 years. The final outcome was rated excellent or good in 87% and fair in 13%.

Leung et al. (1987) studied younger patients (average 40.9 years) with intra-articular fractures in 96.4% using fixator/brace sequential protocol. Excellent and good results were seen in 90.4% of the cases and fair in 9.6%.

According to Gartland and Werley (1951), functional analysis showed 73% of the fractures to have had excellent or good results. More than half of the fractures were classified as Frykman types VII and VIII. Thirteen out of 20 Frykman VII and VIII fractures were classified...
as very good and good and seven as satisfactory. A correlation between function and Frykman classification showed one poor result in the series in a Fryk-man VII fracture. Complications included three cases of pin site infection in a total of 148 bone screws, an incidence of 2%. Two of those infections responded to improved pin site care and antibiotics. In one case the fixator had to be removed prematurely and a cast was applied.

External skeletal fixation is an important minimal invasive procedure in the management of fractures at the distal end of the radius. Attention to detail is important not only in the recognition of indications and function of the external fixator but also in its specific application. To improve anatomical restoration (e.g. palmar tilt) multi-planar ligamentotaxis is recommended (Déé et al., 2000).

Conclusion

Penning Dynamic wrist fixator demonstrates good outcomes with minimal risk in selected fracture patterns. This method can provide adequate fracture stability, and soft-tissue preservation. Patient may return rapidly to function as compared with other methods of treatment.

REFERENCES


Table 1. According to Gartland & Werley assessment System our patients’.

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<th>Score</th>
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<th>Percentage</th>
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