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Prospective study of unstable distal radius fractures treated with external fixation in Indian rural set-up

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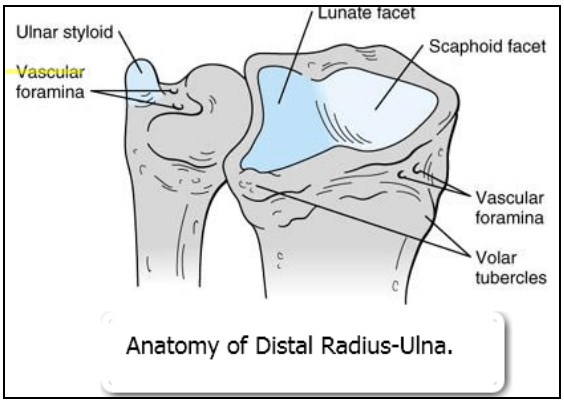
Abstract
Aim: Distal radius fracture is common fracture in daily orthopaedic practice accounting for 1/6th of all the fractures. Conventionally the fractures were treated with closed reduction and immobilization with casts. Even though union of these fractures occurs, they have a very high incidence of going in for malunion and wrist joint instability especially with comminution & intra articular extension cases. Moreover a change in trend to younger age groups as a result of RTA's (road traffic accidents) & trauma is leading to more complicated fractures with intraarticular extension and comminution. Also the importance of anatomical alignment and reconstruction of radiocarpal and radioulnar ulnar joints has been emphasized in recent trends. Hence the management of distal radius fractures changed from universal use of cast immobilisation to operative interventions. Aim of this study is to observe the effect of external fixation for unstable distal radius fractures in rural set up.
Materials and methods: Prospective analysis of 30 patients with unstable distal radius fractures, who were operated at MIMS hospital, nellimarla village, vizianagaram district between may 2016 to feb 2017 treated with external fixator. Patient position- supine with arm table support. For external fixation of the wrist we used the 4 mm (small) external fixator system. For pin insertion into the second metacarpal, the distal pin is inserted proximal to the transition of the metacarpal head into the shaft and the more proximal pin is inserted distal to transition of the shaft into the metacarpal base.The proximal two pins are inserted proximal to the muscle bellies of abductor pollicis longus (APL) and extensor pollicis brevis (EPB). Proximal to these muscles, the radial shaft is palpated through the skin between the bellies of the extensor digitorum communis (EDC) and extensor carpi radialis longus/brevis (ECRL/ ECRB) over a distance of 3-4 cm at which the proximal pins inserted into the radial shaft with 4-5cms apart. Longitudinal traction is applied on the thumb and index finger or the distal partial frame to reduce the fracture. T clamps are fixed to bridging rods, first proximally followed by tightening of distal fragment T clamps to maintain the traction and reduction, there by healing of fracture by the principle of ligamentotaxis.
Results: Average Mean hospital stay is 4days, there are 13males and 17 females between age group 28-60yrs, 27 cases out of 30 had functional and radiological union by 12weeks (range 6-18 weeks), 2 had pin track infection which were treated successfully with iv antibiotics. 1 patient had deep bone infection and pin loosening which was managed with external fixator removal, long course antibiotics and casing. We followed standard Sarmiento radiological scoring system, Gartland and Werley Score (demerit system) demerit point scoring system, DASH scores, Green & O Brien grade scoring systems to evaluate the end results.
Conclusion: External fixation of unstable distal radius fractures can be considered as effective treatment in elderly populations of Indian rural set up as it is simple, cost effective, short duration procedure with good results.

Keywords: Distal radius unstable fractures, external fixation, ligamentotaxis

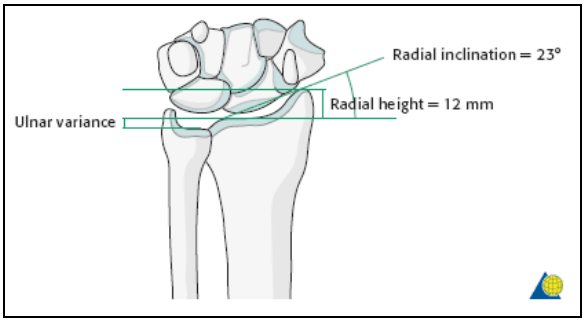
Introduction
Two centuries ever since the publication work of Abraham Colles [1] on fracture of carpal extremity of distal radius, the best management of this fracture is still debatable. Until late 1920s principle treatment of distal radius fracture was forceful traction, manipulation and immobilization with wrist in flexion and ulnar deviation. The result of this position (cotton ladder) led to very high incidence of median nerve neuropraxia. The exact position of immobilization and plaster cast extent varied,

nevertheless treatment essentially remained the same.
It is essential to understand the anatomy of distal radius for proper management of fractures of radius and restoring the function of wrist to its fullest.

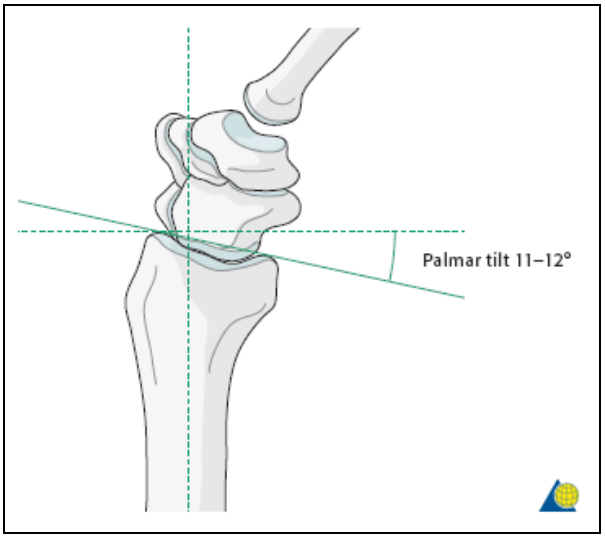


The anatomy of distal radius is unique. The articular surface of distal radius is biconcave, triangular, and covered with hyaline cartilage. A smooth anteroposterior ridge divides the articular surface into two facets: a triangular lateral facet which articulates with the scaphoid, and a quadrilateral medial facet which articulates with the lunate. The medial surface of the distal radius forms a semicircular notch covered with hyaline cartilage, which articulates with the ulna head. This articulation enables the radius to swing around the ulna. The lateral surface of the radius elongates into a prominent styloid process

AO Radiological/ Anatomical parameters of distal radius [2]
AP view
Radial height: the distance between two parallel lines drawn perpendicular to the long axis of the radial shaft— one from the tip of the radial styloid and the other from the ulnar corner of the lunate fossa. Average = 12 mm.
Radial inclination: the angle between two lines—one drawn perpendicular to the long axis of the radius at the ulnar corner of the lunate fossa and the other between that point in the lunate fossa and the tip of the radial styloid. Average = 23°.
Ulnar variance: a measurement of the relative lengths of radius and ulna at the wrist. The distance between two parallel lines drawn perpendicular to the long axis of the radius at the distal articular surface of the ulna and the ulnar corner of the sigmoid notch of the radius. 60% of the population are ulnar neutral.



Lateral view
Palmar inclination: the angle between two lines—one drawn perpendicular to the long axis of the radius and the other between the dorsal and palmar lips of the distal radial articular surface Average = 12°.



Restoration of radial length, radial tilt angle and congruity of articular surfaces is important for good functional results [3]. There is evidence to suggest that anatomical articular reduction greatly reduce the incidence of post traumatic Osteoarthritis [4].
Arora J [5] and others studied patients with comminuted intra articular fractures of distal end of radius treated randomly with either closed reduction & cast application or external fixation. Results outcome was better in external fixation than by conservative means. Conclusion was external fixation was a better modality than conservative to treat intraarticularfractures of distal end radius.
Anderson and O'Neil, were the first to introduce the use of external fixation in the treatment of unstable distal raius fractures [6]. Since then there is a trend to use external fixators in management of these fractures as they give improved results both functional as well as anatomic reconstruction.

Materials and methods
Study involved 30 patients who were operated at MIMS, nellimarla, viziangaram between may 2016 and feb 2017 for unstable distal radius fractures treated with external fixator. Among 30 patients there are 13 males and 17 females with right side (dominant side) being the majorly involved side with the average age of presentation being 44years (range28-60). We followed most commonly used systems of classification of distal radius fractures that is of Frykman's and AO classification

Classification of fracture distal end of radius
Frykman's classification [7]
Type I: Extra articular radial fracture
Type II: Extra articular radial fracture + Ulnarstyloid fracture
Type III:Intra articular fracture of the radio carpal joint.
Type IV: Intra articular fracture of the radiocarpal joint + Ulnarstyloid fracture.
Type V: Fracture of the radioulnar joint
Type VI: Fracture of the radioulnar joint + Ulnarstyloid fracture.
Type VII: Intra articular fracture involving both radiocarpal and radioulnar joints.
Type VIII: Intra articular fracture involving both radiocarpal and radioulnar joints with an ulnar styloid fracture.
AO classificaton [8]
Type A: Extra articular
Type B: Partial articular

Type C: Complete articular
C1: Single articular and metaphyseal
C2: Single articular with complex metaphyseal
C3: Complex articular and metaphyseal fractures
Frykmann Type III, IV, VII, VIII, AO Type B and C is our study group.
After admission thorough physical examination and investigations are done. All patients were counselled about their condition and informed consent was taken from all the patients.
Patient positioned- supine position with arm table support. For external fixation of the wrist we used the 4 mm (small) external fixator system, for pin insertion into the second metacarpal, The distal pin is inserted proximal to the transition of the metacarpal head into the shaft and the more proximal pin is inserted distal to transition of the shaft into the metacarpal base. The proximal two pins are inserted proximal to the muscle bellies of abductor pollicis longus (APL) and extensor pollicis brevis (EPB). Proximal to these muscles, the radial shaft is be palpated through the skin between the bellies of the extensor digitorum communis (EDC) and extensor carpi radialis longus/brevis (ECRL/ ECRB) over a distance of 3-4 cm at which the proximal pins inserted into the radial shaft with 4-5cms apart. Longitudinal traction is applied on the thumb and index finger or the distal partial frame to reduce the fracture. T clamps are fixed to bridging rods first proximally followed by tightening of distal fragment T clamps to maintain the traction and reduction, that is to work on the principle of ligamentotaxis.

Results

Post –op care

1. We gave arm sling for comfort
2. MCP (meta carpo phalangeal joint), elbow joint, Shoulder joint range of movements were encouraged from the 2nd post op day to prevent the joint stiffness.
3. Regular dressing to prevent the pin track infection.

Patients were followed up at 2weeks, 6weeks, 12weeks and 6 months. Follow up xrays were taken. External fixator removal done at 6weeks followed by slab application in necessary cases.
Patients were evaluated clinically and radiologically for union. Clinical union described as no tenderness on clinical examination at old fracture site. Radiological union described as callus bridging or no fracture line after comparing the pre-operative x-ray with the laest follow up x-ray.

Clinical evaluation by using

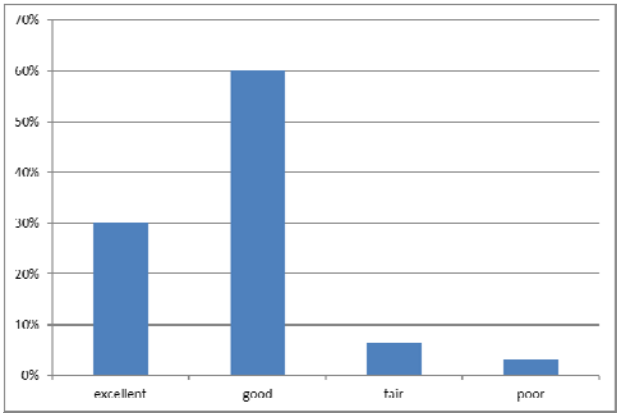
1. Gartland and Werley Score (demerit system)[9] – average score 11.5 (range 2-21)
2. DASH Scoring [10]

The Disability of the Arm, Shoulder and Hand (DASH) upper extremity outcome measure was developed by the American Academy of Orthopedic Surgeons and Institute. It was designed to assess the functional status and symptoms of clients with upper extremity conditions. The DASH contains 30 items, most of which describe the amount of difficulty the patient faces while performing various physical tasks due to arm, shoulder or hand problems (21 items). The DASH can also be used to monitor patient status over time and measure the therapeutic effectiveness of a particular method of intervention.

3 Sarmiento radiological scoring [11]
4 Green and O'Brien Score (Cooney modification) [12] - average score 77 (range 62-92) Total cases –30

Age	Males - 13	Females - 17
20-30 years	2	2
30-40 years	4	5
>40 years	7	10

Of the 30 cases 24 of fractures are Frykman's type III and type IV, 5 cases are Frykman's type VII, 1 case belong to Frykman's type VIII, all the patients were treated with external fixator and results were evaluated based on the above scores, of them 9 (30%) had excellent results, 18 (60%) good results, 2 (6.6%) had fair results, 1 (3.3%) had poor result.



Pre–op x-ray Immediate post –op x-ray

Pre–op x-ray Immediate post –op x-ray

Discussion

Abraham Colles in 1814 described a fracture of distal end of radius with in an inch from lower articular margin and its typical deformity. Plaster slab and cast were used for long duration for management of such fractures.
External fixation to treat fracture distal end of radius was first introduced by Andersen and O'Neil in 1944. Coonly 1979 to 83 in his study has stated that skeletal traction maintained by the half frame external fixator between the radius and second metacarpal appears to provide appropriate stabilization of the

fragments.

External fixator works on the principle of ligamentotaxis. Vidal [13] 1977 to 80 is the first who used the principle of ligamentotaxis by external fixator for the treatment of distal end of radius. The concept of continuous distraction (ligamentotaxis) is the basic for the use of external fixator for distal radius fracture. With distraction, the soft tissue surrounding the fracture help to mould the bony fragments and facilitate reduction and it restores skeletal length and maintains reduction during healing process.

The Roger-Andersendevice used by Grana WA, Kopta JA [14] in the treatment of distal radius fractures had 80 % excellent and good results. They felt that 4 pins gave better fixation and pin loosening was less when compared with 2 pins.

Cooney WP[15] analysed the results with four different external fixation devices in a consecutive series of 100 unstable distal radial end fractures and opined that quadrilateral frame fixation provided effective immobilization and produced good to excellent results in 86 % of patients.

Bassett RL [16]. emphasized on anatomical reduction and sufficient distraction with external fixators in managing distal end of radius fractures.

Studies of Vaughan PA, Lui SM, Harrington JJ, Maistrelli GL [17]. Using Roger Anderson external fixator in the treatment of unstable fractures of distal radius in 52 patients and the results were evaluated after a follow up averaging 58 months. They had 89 % good or excellent and 11 % fair results. There were no poor results.

Kogsholm J, Olerud C [18]. compared 75 patients with Frykman type VIII fractures of distal radius treated by primary external fixation and closed reduction. They concluded that all the fractures treated with external fixation remained well reduced and aligned, whereas 88 % of these treated with cast had unsatisfactory alignment. The external fixator group also had superior results with respect to functional outcome, range of motion and grip strength.

In 2000 Harish Kapoor, Ashoo Agarwal & B. K. Dhaon [19]. Carried out a comparative evaluation of results following closed reduction, external Fixator and open reduction internal fixation. 90 adult cases of acute displaced intra-articular fractures of lower end of radius were classified according to Frykman's classification & AO classification and concluded that External fixation gave 80 % good and excellent results, 20% fair and poor results.

The external fixator is a versatile tool that is now well established in the treatment of distal end radius fracture and many studies have concluded superiority of this over other modalities especially in unstable comminuted fractures.

Conclusion

External fixation of distal radius unstable fractures can be considered as effective treatment in elderly population in Indian rural set up as it is simple cost effective procedure with good results. It significantly reduces the malunion rates and allows for early mobilisation of small joints of hand hence better functional outcome in elderly osteoporotic patients. It also has similar functional outcomes in younger age group who preferred external fixator treatment for cosmetic purposes.

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