

Management of fracture of distal radius by external fixator using the principle of ligamentotaxis a prospective study

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Abstract

Background and objectives: Fracture of distal end of radius continues to be one of the most common skeletal injuries since the description by Poteau in 1783 and by Colle's in 1814. Management of these fractures is still a challenge for orthopaedic surgeon in achieving good functional results. Numerous techniques have been described and developed to treat the fracture in an effort to improve the outcome. A prospective study of management of fracture-distal radius by external fixator using the principle of ligamentotaxis was conducted at our institute to evaluate the clinical efficacy of external fixator with ligamentotaxis in distal radius fracture reduction, fracture healing, functional recovery after surgery and common complications encountered.

Methods: A prospective study of 30 cases of fracture lower end of radius in age group 20-60 years was done who were treated with ligamentotaxis in the department of orthopaedics at our institute from June 2008-october 2011. Fracture was anatomically reduced and fixed with Joshi's external fixator with ligamentotaxis. All patients were monitored for pin tract infection and other complications. Active finger movements were advised by the patient from second post operative day. Regular clinical examination, periodical check X-rays were taken to assess the union of fracture. Patients were followed up to 2years with average duration of 9 months.

Results: We found that in all cases there was union of fracture on an average of 6weeks. There was no case of non union; there were 5 cases of acceptable malunion and 4 cases of joint stiffness and one case of pin tract infection

Interpretation and conclusion: With external fixation and ligamentotaxis the result in majority of cases was either excellent or good. Hence we concluded that external fixator with ligamentotaxis is a good method of treatment in fracture distal end of radius.

Key words: Distal end radius, Colle's fracture, ligamentotaxis, External fixation, closed reduction

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Introduction

Fracture of the distal end of radius is one of the most common fractures. It occurs in middle aged and elderly women commonly. It also occurs in young men with high velocity injury though less in number. With increase in longevity and activity in middle aged to elderly population, there is increase in number of these fractures^[1]. Patients with fracture distal end of radius have serious complications more frequently than generally appreciated^[2] and failure in management may cause permanent disability^[3]. Distal radius fractures crush the mechanical foundation of the man's most elegant tool, the hand. Fit middle aged patients do not expect their wrist to be deformed and do expect a strong mobile hand. Previous policies of benign neglect, is no longer acceptable. Therefore treatment methods are continually improving and best suitable method of management has to be followed in each case^[1]. Pain and disability have resulted from subsequent malunion of unstable fracture of distal radius which were managed by conservative method like plaster cast

alone^[4,5]. With increasing demand in functional recovery previously held dictum of cast treatment for patients with distal radius fractures are being challenged both by surgeons and society, although some patients still seem to confirm Abraham Colle's famous remark that stated "wrist will at some remote period again enjoy perfect freedom in all of its motion and be completely exempt from pain", an increasing preponderance of published studies support the need for operative intervention in these patients^[6]. Recently surgical management has been widely recommended and performed to prevent disability. Several studies has shown convincingly that functional outcome is good when the anatomy is restored by obtaining good reduction of fracture fragments, maintaining the angulations of the articular surface of radius and radial length.^[7,8,9]

Various surgical interventions are available presently, like percutaneous pinning, intra focal pinning, external fixator and plate fixation^[10]. External fixator may be performed in a bridging technique and a non bridging technique. Bridging external fixator allows distraction across the radio carpal joint^[6]. The moulding of fracture fragments into alignment by traction force applied across the fracture through the surrounding soft tissue is known as ligamentotaxis. Anderson and O Neil were first to maintain fracture reduction with an external fixator using the principle of ligamentotaxis. Multiple studies have documented the

efficacy of this technique [11,12, and 13]. The present study "Management of fracture of distal end of radius by external fixator using the principle of ligamentotaxis – a prospective study" was undertaken in department of orthopaedics at our institute to study fracture healing and functional outcome in distal radius fracture following external fixation with ligamentotaxis.

Aims and Objectives

To study the role of external fixation and to determine the importance of anatomical reduction in distal radius fracture. To study, the role of ligamentotaxis in the management of distal radius fracture. To know the advantages, disadvantages and complications by using external fixator with ligamentotaxis and to evaluate the results of fracture distal end of radius managed with external fixator with principle of ligamentotaxis.

Materials and methods

Thirty patients who have sustained fractures of the distal radius admitted in the department of orthopaedics at our institute were studied. The inclusion criteria followed was adults between age group of 20 years to 60 years with fracture lower end of Radius, closed and open fractures (Gustilo – Andersons type I and II), fractures less than 2 weeks old, comminuted fracture lower end radius and intra articular fracture of lower end radius. The patients with pathological fracture more than 2 weeks old, non-union, fracture with neurovascular complications, fracture associated with other bone fracture in the wrist hand or forearm and complex fractures with depression of articular surface and fracture radial styloid were excluded from study.

Methods

Patients with distal end radius fractures admitted in our institute after meeting the inclusion and exclusion criteria were taken up. All patients were evaluated preoperatively by clinical and roentgenographic examination. Systemic, haematological investigations, chest X-ray and assessment of cardiac status using ECG were done as a routine with pre anaesthesia evaluation. Preoperatively patients were immobilized with Plaster of Paris or splints. Patients were informed about the operative procedure and consent taken.

Surgical Technique

Under regional block anaesthesia or General Anaesthesia depending upon anaesthesiologist preference, patient was placed supine on the operating table. The forearm and hand were scrubbed with betadine and saline. The tourniquet was applied over the arm. The forearm and hand were painted with betadine and draped. The operating forearm was placed on a radiolucent arm-board. Closed reduction was done under C-arm. Wound debridement and wound care was

given in compound fracture. In our technique, 5mm incision for 4 shanz pins, 2 in the middle third of the radius on the dorso lateral aspect about 10-12cm from distal end of radius and 2-3cm apart. We have done soft tissue dissection using a haemostat, care taken to avoid injury to radial nerve. Another 2 incision over the base of the second metacarpal on dorso lateral aspect about 1-2cm apart were done, 3mm shanz pin were inserted in the radius, and 2.5mm Shanz pins were introduced in second metacarpal, then with fixator pins securely in place, clamps and external fixator rod were mounted to shanz pin. The clamps were loosened and longitudinal traction was given with manual moulding of.

The fracture fragments back into a more normal alignment and gentle flexion and ulnar deviation was maintained. The reduction was confirmed through image intensifier and then external fixation device was locked into place. The tension across the wrist generated by the external fixator device which provides enough ligamentotaxis was confirmed by image intensifier wherein, radio carpal articulation was seen to be 1 mm wider than the mid-carpal joint in Antero-posterior projection (Fig-1). The average duration from the date of injury to the date of operation was 4 days ranging from 1st to 14th day.

Postoperative Care and Rehabilitation

The check X-rays were taken in both anteroposterior and Lateral views. The reduction of the fracture was confirmed and amount of distraction was also studied by radio carpal joint space in anteroposterior view, which should be 1 mm wider than the midcarpal joint space. Active exercises of fingers, thumb, elbow, forearm and shoulder were commenced from the day 1 of operation. On the 3rd post operative day the dressing was removed. The pins were cleaned and small dressing around the pins was applied. Patient was discharged after the 3rd day with an advice to clean the pins alternate days and was followed up after 2 weeks, 4 wks, 6wks, 8 wks and 12 wks. On demonstration of the radiological union, the external fixator was removed after 5-7 weeks (average 6 weeks) and physiotherapy of the wrist was commenced. A removable splint for forearm was applied during night time and was removed during day time for physiotherapy for another 2 weeks and wrist and finger exercises were taught to continue at home. The follow up period was ranging from minimum 3 months to a maximum of 24 months (Average 9 months). During the follow up, all the patients were observed for any possible complications. Each patient was evaluated for functional recovery at the end of three months and also at the latest follow up visit up by clinical and radiological examination.

External Fixator

The Joshi type of External fixator was used in our study. This fixator consists of, distractor bar attachment

with the Schanz pins. In our series, the Joshi type of External fixator was applied in all the cases. We have used two 3mm Schanz screws for radius and two 2.5 mm schanz screws for the second metacarpal and 4 mm connecting rods.

Instruments Used for the Procedure

External fixator set, spanner No 7 & 8, drill-bits, electric drill or hand drill, T handle, scalpel blade and image intensifier.

Observations and Results

In our study, 30 patients with the age group of 21-60years with an average age were 38years were studied. 17 were male and 13 were female patients. The most common mode of injury was fall on outstretched hand, right side was more commonly (56.67%) involved and majority of cases were of closed type (86.67%). A3 type was 40%, according to AO classification (Table 1).

Table 1

AO Type	No of cases
A2	6
A3	12
B2	2
B3	3
C2	5
C3	2

Results

The assessment of functional outcome was made according to modified clinical system of Green and O'Brien 1978 and Brad way et al 1989. This modified score includes independent scores for motion, Strength, pain, and activity level, which can be objectively graded as per the Table 2. To achieve an excellent result, full range motion of wrist and forearm, strength, function of hand and comfort must be present.

Table 2: The Modified Green- O'Brein clinical scoring system

Category	Score	Findings
Pain	25	None
	20	Mild
	15	Moderate (medication required)
	00	Severe (requires narcotics)
Function	25	Same job
	20	Different job
	15	Able, no job
	00	Unable
Motion	25	100%
	15	75-99%
	10	50-74% of normal side
	5	25-49%
	00	0-24%
Strength	25	100%
	15	75-99%
	10	50-74% of normal side
	5	25-49%
	00	0-24%

Note: Motion and strength as percent of normal side.

Scoring: Excellent: 90-100%

Good: 80-89%

Fair: 65-79%

Poor: <65%

Overall results were graded as acceptable (excellent and good), fair or poor. In our study, six patients had full range of movements, no pain, returned to previous job and had 100% strength to that of normal side and the results were considered as excellent (Fig. 1, 2, 3 and 4). Another three patients had full range of movements as compared to that of opposite side with mild pain not affecting the function of wrist. They also scored more than 90% and the results were considered as excellent. 14 patients had limitation of movements of wrist and forearm by 20% and decreased hand strength by 15-20% as compared to that of normal side, but they did not have pain. The function of hand was not affected and they continued their previous profession. They scored 80% and the result was considered

as good. Five patients had limitation of movements of wrist and forearms by 25% as compared to that of normal side, with mild pain, unable to lift heavy weights and their hand grip strength was also decreased by 20 to 25 % as compared to that of normal side. They scored between 65 – 79% and the results were considered as fair. Two patients had moderate pain, which was subsiding with analgesics. They were unable to do heavy manual work, but could carry out daily activities. They had restriction of wrist movements by 50% as compared to that of normal side. They scored less than 65% and the result was considered as poor. The overall results were estimated according to modified Green- O'Brien clinical scoring system, 1978. The results of management of 30 intra-articular fracture of distal end of the radius were as follows in Table 3.

Table 3: Functional outcome

Outcome	No of cases	Percentage
Excellent	9	30.2%
Good	14	46.66%
Fair	5	16.66%
Poor	2	6.66%

INTRA-OP PHOTOGRAPHS



Painting & Draping



Small Skin incision



Drilling



Shanz pin application



Mounting distractor bar



External Fixator in distraction

Fig. 1



Fig. 2



Fig. 3



Extension



Flexion



Radial Deviation



Ulnar Deviation



Pronation



Supination

Fig. 4



Fig. 5

Discussion

Management of fracture distal end of radius is still a challenge for orthopaedic surgeon and pose therapeutic problem in term of reduction of fracture, maintenance of reduction till the fracture unites mobility of the joint after fracture union. Failure in the management may cause permanent disability^[14]. We agree with Green^[9] that a good functional result usually accompanies a good anatomical reduction. Failure to identify the unstable fracture by the degree of displacement, severity of the comminution, the involvement of radio carpal or radioulnar joint^[9]. Recently surgical management is being preferred over conventional method to prevent disability in unstable fracture^[15]. Bridging external fixator with ligamentotaxis for treatment of fracture distal end of radius has given promising results.^[16] The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture^[6].

In our study we treated 30 cases of fracture distal radius with external fixator using the principle of ligamentotaxis. There were 17(57%) males and 13 (43%) female patients. The increase in number of male patients is because of increase in number of road traffic accident and high energy trauma which was noticed in young adults. We restricted our study group from 20-

60yrs, because management and rate of union differ in younger and older age groups. The peak incidence in our study was in age group of 30-40 years and average age was 38 years. There were 4 compound injuries and in all 4 cases wound was on volar side, 3 of them were type I, and one was type II (Gustilo-Anderson). Surgery was delayed in one case till the wound healed and none of them had post operative infection. It was easier to manage wound after the application of external fixator. In our study, one patient was diabetic and two were hypertensive, there were no medical problems in others. In all 3 cases disease was well under control. There was no systemic complication during preoperative, intraoperative or post operative period. The medical problems did not come in the way of fracture management, fracture healed well in 6-8 weeks. There was one case of pin tract infection despite meticulous wound care and antibiotics, with minimal discharge and pin loosening. We had to remove the external fixator early at 5 weeks and give a wrist splint, there was mild malunion and restricted movements at wrist, with poor result, but patient did not develop osteomyelitis. Infection subsided after external fixator removal and oral antibiotic treatment.

There were 5 cases of malunion 2 were dorsal tilt and 3 with lateral tilt but with minimal restriction of movements and functional disability. Out of 5 cases there were 2 cases of comminution. There were 4 cases of wrist stiffness probably because of wrist

immobilization for 7 weeks and 2 patients developed feature of RSD (reflex sympathetic dystrophy) because of inadequate physiotherapy. Out of 4 cases one developed reduced range of pronation and supination, because of involvement of distal radioulnar joint. In all the 4 cases there was reduced hand grip strength. We did not come across any case of non union and neurological deficit either because of fracture or because of external fixator.

Table 4: We compared our results of Jenkins N.H. et al^[4]

Study	No of cases	Excellent	Good	Fair	Poor
Jenkins et al	32	13	17	1	1
our study	30	9	14	5	2

The functional outcome in our study was 30.2% excellent, 46.66% good, 16.6% fair and 6.6% poor, as compared to 40.6% excellent 53% good 3% fair and 3% poor results of Jenkins et al study^[4]. After comparison we noticed that our study had excellent and good result in 76% of all cases.

Conclusion

The present study "Management of fracture of distal radius by external fixator using the principle of ligamentotaxis a prospective study" was conducted at our institute from June 2008-october 2011. The study included 30 cases of fracture distal end of radius presenting to our hospital. For all patients a thorough clinical examination was carried out, required X-rays were taken; initial treatment was given and admitted as in-patient. After selection of patients, according to inclusion criteria careful preoperative planning and evaluation was done, patients were operated for fracture distal end of radius with Joshi's external fixator using principal of ligamentotaxis. External fixator was removed after 5-7 weeks. From the present study on 30 patients with distal end radius fractures we conclude the following: Fracture of distal end of radius is more common in age group between 31-40yrs and more common in males, and more commonly seen because of fall on outstretched hand. Right side was affected more than the left side. Restoration of anatomy of distal end of radius, early mobilization and less complication were achieved using external fixator. After meticulous post operative care, patients were followed up for clinical and radiological union, complication and functional recovery observation and results were analyzed using Modified Green-O-Brien clinical scoring system, there were 30.2% excellent, 46.66% good, 16.6% fair and 6.6% poor result. Result was good in many patients. Hence we concluded that external fixator with

ligamentotaxis is a good method of treatment for fracture of distal end of radius.

Conflict of Interest: None

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