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Functional Outcome of Distal Radius Fractures Managed by Ligamentotaxis and/or Percutaneous Pinning vs Open Reduction & Internal Fixation by Buttress Plate

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Original Research Article

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Abstract: The fracture of the distal end of radius are the most common fractures that we encounter. With the increase in high velocity trauma, there has been an increase in the incidence and fracture patterns of the distal radius We conducted a prospective on distal radius fractures with 30 patients. All cases of distal radius fractures were considered between the age group of 25 and 70 years. Frykman's classification was used to classify the fractures. The patients were followed up every three weeks following surgery. The patients were assessed subjectively and objectively using New York Hospital Wrist Scoring system. The anatomical and functional results were good in 44.44% of patients treated with external fixation. There were no patients having good functional outcome at the end of one-year follow-up with internal fixation. 22.22% of patients treated by external fixation had fair results while 75% of the patients managed by internal fixation had fair results. Under the category of poor results, there was 33.33% of external fixation and 25% of buttress plating. The fair and poor results were due to pin tract infection in external fixation whereas it was loss of joint motion in internal fixation, due to difficulty intra articular geometry of the fracture pattern. The incidence of complications in internal fixation (25%) were fewer compared to external fixation.The incidence of complications and poor results in internal fixation are fewer when compared to external fixation in this study. Patients managed with buttress plating had better functional outcome and returned to their daily routine earlier than those patients managed with ligamentotaxis.
Keywords: distal radius fractures, ligamentotaxis, buttress plating

INTRODUCTION

The fracture of the distal end of radius are the most common fractures that we encounter. With the increase in high velocity trauma, there has been an increase in the incidence and fracture patterns of the distal radius. In younger individuals, with good bone stock, intra-articular involvement has been more common. Plaster application in these fractures results in a lapse of functionality of the wrist and unsatisfactory cosmetic finish. Radial shortening, finger stiffness and wrist joint arthritis are common sequelae. Many methods of treatment have been tried to circumvent these problems.

Percutaneous fixation of the displaced fragment under radiological control, supplemented by external fixator has given excellent results. Volar or dorsal rim fractures of distal radius demand the need for buttress plate fixation. The results of closed reduction followed by immobilization in external fixation and buttress plating provide a viable, stable and better alternative to the physiologically young patients whose work schedule places a heavy load on the wrist.

The common indications for external fixation of distal radius include unstable extra-articular fractures with significant comminution, comminuted intra-articular fractures, compound fractures, fractures hat fa to maintain reduction with POP splint and that of Buttress plating is done when there is a compression fracture to provide a buttress against compression.

Thus the upcoming modality of treatment of unstable fractures of distal end of radius with intra-articular extension is either by external fixation or buttress plating.

AIM OF OUR STUDY

Our aim of the study is to compare the functional outcome of distal radius fractures managed by ligamentotaxis and/or percutaneous pinning versus open reduction and internal fixation by buttress plates.

TYPE OF STUDY

Ours is a prospective study of intra-articular fractures managed by external versus internal fixation

MATERIALS AND METHODS

The Study was conducted at department of Orthopaedics and Traumatology, Sree Balaji Medical College and Hospital, Chennai from August 2015 to August 2017. 30 patients with fracture of the distal end of radius, with intra-articular extension were included in the study.

All the patients included in study were classified and studied as per Frykman's classification of distal radius fractures and were treated as in-patients.

Patients were managed with a uniaxial distraction system under supraclavicular block or axillary block. After removal of the external fixator (3-6 weeks of fixation), the patients were put in continuous passive motion and early wrist movement was encouraged. The results obtained were evaluated and compared in terms of functional outcome, fracture union, anatomical reduction.

Surgical technique (external fixator)

Regional anaesthesia was the preferred choice, either supraclavicular or axillary block. One patient in our study had a left femur fracture, in whose case general anaesthesia was administered. Patient was placed supine position with the affected limb abducted at shoulder and wrist placed on a side table.

LIGAMENTOTAXIS

Procedure

External fixator was applied in the operation theatre under sterile conditions. The pins used for radius were of 3.5mm Schanz pins and that for metacarpal were 2.5 mm Schanz pins.

After scrubbing, painting, draping (with or without pneumatic tourniquet), a small incision was taken on the dorsolateral aspect of the forearm about 3-5 cm proximal to the fracture site. Lateral cutaneous nerve of the forearm was identified and 3.5 mm Schanz pin was inserted.

Second pin site was selected beyond mid forearm proximally (greater this distance from the first pin in distal end of radius 3-5 cm proximal to fracture site, more stable the fixation).

Two Schanz pins of 2.5 mm were inserted on the lateral surfaces with the first one being passed into the base of the second metacarpal to the third metacarpal base and the second Schanz pin of 2.5 mm was passed into the neck of second metacarpal. The radial and metacarpal pins were connected by an external rod. Reduction was achieved under image intensifier. The best position seemed to be in ulnar deviation of forearm.

Post operatively, upper limb was monitored for neurovascular deficit. Early mobilisation of digits, elbow and shoulder was encouraged.

Patients were discharged in a day or two and called for follow up at the seventh day for dressing, fourteenth day for staple removal and dressing and then once every week until four weeks. During the follow up period, patients were instructed to do the exercises and were taught the cleaning of pin sites with saline and soap water. Early pin tract infection if any was treated with oral antibiotics. Fixator was left in situ for 6-8 weeks. Fixator removal was considered only after clinical and radiological evidence of fracture healing.

Fig-1.1: Radiograph ligamentotaxis

Fig-1.2: External fixation on Day 2

Fig-1.3: Ligamentotaxis with K-wire Done

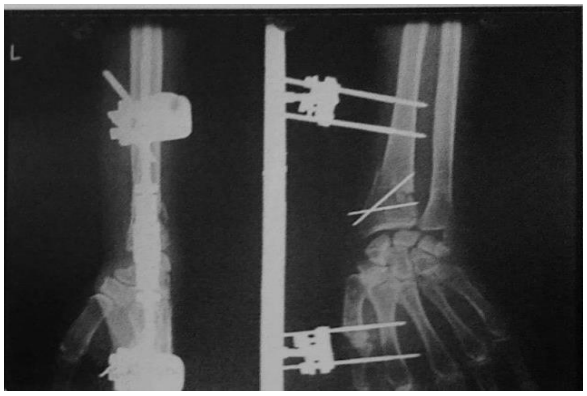

Fig-1.4: Surgical technique (internal fixation): buttress plating

Procedure

Regional anaesthesia was the preferred choice, either supraclavicular or axillary block. Through Volar approach, after painting and draping, a longitudinal incision of about 7.5 cm long was made on the radio volar aspect of the distal forearm. The plane between the flexor carpi radialis and the Palmaris longus was developed. The flexor pollicis longus tendon was retracted radial ward and the median nerve and the other tendons were retracted ulnar ward. The fibers of the pronator quadrates were erased from their origin on the radius and fracture was exposed.

Buttress plate fixed by dorsal approach

Dorsal approach: After painting and draping, an 8cm longitudinal incision was made on the dorsum of the wrist, crossing the wrist along the midpoint of radial and ulnar styloids. The incision begins 3 cm proximal to wrist joint and ends about 5 cm distal to it. Once the fascia is dissected, the retinaculum is exposed. The retinaculum is divided to expose the fourth extensor

compartment containing the extensor digitorum communis and extensor indicis tendons.

Fracture was reduced and a buttress plate was contoured so that, when it is applied and fixed to the proximal fragment, the distal transverse part will act as a buttress and hold the fracture reduced. A minimum of two screws were inserted in the proximal fragment.

The reduction of the fracture and restoration of the articular surface were confirmed by direct observation and by antero-posterior and lateral views in C-arm. Pronator quadratus was replaced over the plate to its origin on the radius and wound was closed.

Fig-1.5: volar plate fixation

Comparasion of the surfaces of volar and dorsal aspect of radius

In this study volar approach was found to be more advantageous because of the smooth and flat surface of bone where the plate could be placed well. A better buttress effect was provided against volar collapse. There was also no evidence of tendon rupture in this approach. Post operatively, the upper limb was elevated for 24 hours with monitoring of neurovascular status. Early motion of digits, elbow and shoulder was encouraged.

Pecutaneous pinning

Procedure

The fracture fragment was manipulated and reduced. Two large unthreaded Kirschner wires were inserted through the radial styloid across the fracture and into the opposite metaphyseal cortex using a power drill, under the C- arm guidance, while an assistant maintained the reduction. The arm was immobilized in a below elbow slab with the wrist in reduced position.

Post operatively hand was elevated for 24 hours with monitoring of neurovascular status. Early motion of digits elbow and shoulder were encouraged. The Kirschner wires were removed at six weeks. The wrist was then supported with a splint for 2 weeks, and gradual range of motion exercises was permitted. Patients were followed up every two weeks till six weeks, then every 3 months till one year.

RESULTS

The following observations were made from the data collected during our study. A total 30 cases were taken for study out of which 16 were males and 14 were females [Tab 1.1]

Table-1.1; IF: Internal Fixation, EF: External Fixation

SEX	NO OF CASES	IF	EF	PERCENTAGE
Female	14	4	10	46.67%
Male	16	8	8	53.33%
TOTAL	30	12	18	100%

The Majority of the Patients belonged to the age group 30 to 50 Years. The youngest patient in the case study is 30 years old and the oldest patient was 70 years old.

Tab-1.2: In this study the predominant cause of injury was high energy trauma due to road traffic accidents followed by fall on out stretched hand

MODE OF INJURY	NO OF CASES	PERCENTAGE
RTA	20	66.67%
FALL	10	33.33%
TOTAL	30	100%

Tab-1.3: In our study the largest number of cases were of Frykman type III []

FRYKMANS CLASSIFICATION	NO OF PATIENTS
TYPE I	0
TYPE II	0
TYPE III	10
TYPE IV	4
TYPE V	4
TYPE VI	4
TYPE VII	6
TYPE VIII	2

The measurements of wrist movements revealed mean dorsiflexion of 48^{o} compared with 70^{o} on the normal side. Mean palmar flexion was 28^{o} as compared with 90^{o} on uninjured side. The average supination and pronation was 44^{o} and 53^{o} respectively. The average ulnar and radial deviation at wrist was 20^{o} and 14^{o} respectively.

Tab-1.4: Range of movements after 12 weeks compared with normal side

WRIST	NORMAL ROM	RESULT (AVERAGE)
Dorsi flexion	70	48
Palmar flexion	90	28
Ulnar deviation	25	20
Radial deviation	25	14
FOREARM		
Supination	90	44
Pronation	90	53

Fig-1.5: Range of Movements

In accordance with the statistical figures the anatomical and functional results were good in 44.44% of patients treated with external fixation. There were no patients having good functional outcome at the end of one-year follow-up with internal fixation. 22.22% of patients treated by external fixation had fair results while 75% of the patients managed by internal fixation had fair results.

Under the category of poor results, there was 33.33% of external fixation and 25% of buttress plating. The fair and poor results were due to pin tract infection in external fixation whereas it was loss of joint motion in internal fixation, due to difficulty intra articular geometry of the fracture pattern. The incidence of complications in internal fixation (25%) were fewer compared to external fixation (33.33%) in this study. [Tab 1.5]

Table-1.5: NYOHWSS: New York Orthopaedic Hospital Wrist Scoring system

NYOHWSS	NO OF CASE WITH IF	%	NO OF CASE WITH EF	%
EXCELLENT	4	33.33%	0	0%
GOOD	0	0%	8	44.44%
FAIR	6	50%	4	22.22%
POOR	2	16.67%	6	33.33%
Total	12	100%	18	100%

DISCUSSION

The fracture of the distal end of radius was first identified by Sir Abraham Colles in 1814 [1,2]. This was an extra- articular fracture and occurred in elderly individuals with osteoporotic bones'. He described six classical deformities and advocated plaster cast as the treatment of choice Even after so many years after Sir Abraham Colles described, the percentage of unsatisfactory results continues to be high.

Increased awareness of the complexity of Colles fracture has stimulated a growing interest and prompted newer ideas regarding their management. Although closed reduction with cast immobilization remains a reliable standard of treatment for stable extra-articular fractures and minimally displaced articular injuries, similar management for unstable articular disruption is prone to fail.

Ever since Bohler [1] advocated the use of fixed pin traction to maintain the reduction for comminuted fracture of the distal end of radius, this method has been recommended and modified by many surgeons. Then, came the external fixator in the treatment of these fractures, growing in popularity because of their sound mechanical stability and fixed traction which prevents shortening due to initial bone loss and later resorption of the cancellous bone in the metaphysis of the distal radius.

Secondary reconstruction is difficult and repeated manipulations appear to increase the risk of algodystrophy. It therefore seems that fractures of the distal radius should be treated by principles usually applied to other articular fractures. Intra-articular fractures with a step of over 2mm in the radiocarpal joint inevitably result in osteoarthritis and functional impairment. It is therefore important to reconstruct the joint surface and make it congruent. Plating (T -plate) enables both the radiocarpal and radioulnar joints to be perfectly restored.

In our study, Frykman's classification was used for classification of the fracture type. In our present series, the number of males was more than females, left sided fractures were commoner than the right sided fractures and two had bilateral fractures. Road traffic accidents were the main cause of injury. Frykman type III was the commonest fracture pattern in our study. Two patients had associated injuries like subtrochanteric fractures.

Distal radius fractures account for 20% of all fractures and are only second to hip fractures in terms of incidence in the elderly population [15]. The present lifetime risk of sustaining fracture is 15% for women and 2% for men [15]. In our study there were 14 males and 12 female patients indicating the incidence is no longer limited to females.

Fragility fracture of the distal part of the radius is a major source of patient morbidity. In the study of 240 patients 181 were women and 59 were men with the mean age of 76 years [16]. Of the 65 patients of unstable Colles fracture studied at Mayo's clinic, 53 were women and7 men [20], the mean age was 63 years [3]. This indicates that distal radius fractures were more common in the geriatric group [20]. In our study 42.3%of the cases were in the age group of 30 to 40 years. This shows that distal radius fracture is not necessarily confined to geriatric age group [20]. Thus the incidence of distal radius fractures is increasing in younger age group too.

W P Cooney, in his study of 65 patients of unstable Colles fracture found that 50 patients sustained injury due to fall on outstretched hand [20]. 6 patients sustained a motor vehicle accident. No specific mechanism of injury was recorded in 4 patient [20]. In our study, 77% of the patients sustained distal radius fracture following RTA, 23% of patients were injured following fall on out stretched hand. This leads us to conclude that high energy trauma has surpassed self-fall as the major cause for distal radius fractures.

All patients were followed for a minimum period of 6 months. At each visit patient was evaluated clinically and radiologically and the final results were analysed using New York Orthopaedic Hospital Wrist Scoring system. Despite wide spread enthusiasm for plating, current literature does not demonstrate the clear benefit of plating. When a fracture is well reduced either technique will provide similar good results. In this study 31% of the patients were treated by internal fixation (buttress plating) and 69% by external fixator.

A number of studies have reported favourable results with external fixation, although most of the studies were retrospective and, thus are difficult to interpret due to the heterogeneous group of patients with

a variety of skeletal and soft tissue injuries and also different age groups. In a study by Jesse B. Jupiter [1], the incidence of complications was high ranging from 20 to 60% [4]. The complications included infection of pin tract, radial sensory neuritis, reflex sympathetic dystrophy, stiffness of the wrist, pre-drilling have reduced the problems related to pins, the potential for wrist stiffness still remains a concern. In a landmark study in 1979, Cooney et al. [20], reported only a slight loss of motion in patients who were followed for two years or more [4]. The range of motion of the wrist that was reported by Clayburn [11] in 1987, who used a mobile external fixator, showed little, if any, improvement compared with the series of Cooney *et al.* [20].

As studied by previous surgeons' complications encountered in this study were in concurrence with the literature. The most common complications encountered in our series were pin tract infection, pin loosening and finger stiffness. In 2 patients' infection was superficial and relieved by regular antiseptic dressings and oral antibiotics. Two patients had wrist pain which got relieved with analgesics and physiotherapy. Two patients had finger stiffness and two had pin loosening, which required Repositioning.

The measurements of wrist movements revealed mean dorsiflexion of 48o compared with 70o on the normal side. Mean palmar flexion was 28o as compared with 90o on uninjured side. The average supination and pronation was 44o and 53o respectively. The average ulnar and radial deviations at wrist were 20o and 14o respectively.

CONCLUSION

The surgical fixation of distal radius aims at maintaining fracture reduction and to avoid late collapse. The different surgical techniques employed in treating distal radius fractures includes external fixator, percutaneous pinning and buttress plating. Good anatomical reduction is achieved by treating the distal radius fractures with buttress plating with an added advantage of re-establishment of radial length. Early mobilisation can be started to achieve better outcomes. Distal radius fractures treated with external fixation provide good results in fracture healing with more incidence of complications when compared to internal fixation.

This is a short term study on distal radius fractures with thirty patients only. A longer follow-up number with larger number of patients and a longer follow up, may give us better understanding of this complex problem.

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