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Ajaz Ahmad Bhat
Medical Officer, Department of
Health, Jammu Kashmir, India

Javid Ahmad Nabir
Postgraduate Scholar,
Department of Orthopaedic,
GMC Srinagar, Jammu Kashmir,
India

Fayaz Mustafa Wani
Postgraduate Scholar,
Department of Orthopaedic,
GMC Srinagar, Jammu Kashmir,
India

Corresponding Author:
Ajaz Ahmad Bhat
Medical Officer, Department of
Health, Jammu Kashmir, India

Outcomes of pin and plaster versus locking plate in distal radius intraarticular fractures

Ajaz Ahmad Bhat, Javid Ahmad Nabir and Fayaz Mustafa Wani

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Abstract

Distal radius fractures are among the most prevalent fractures. They are treated via a variety of methods, but the best treatment has not been defined yet. This study was performed to compare the results of open reduction and internal fixation with locking plates versus the pin and plaster method. In this prospective study, 100 patients aged 30 to 60 years with Fernandez type III were selected randomly from August 2016 to August 2018 at Department of Orthopaedics, GMC Srinagar after obtaining informed consent. They were treated with pin and plaster fixation (n = 50) or internal fixation with the volar locking plate (n = 50). Both groups were compared at the one year follow up. Demographic features and standard radiographic indices were recorded and MAYO Wrist Score was used for outcome. Pain (P = 0.564) was not significantly different between the groups. In the plating group mean MAYO score (P < 0.001) was more than pin and plaster group. The rate of acceptable results of radiographic indices (P < 0.001), grip strength (P < 0.001) and range of motion in supination-pronation (P < 0.001) in plating method were better than the pin and plaster method.

Conclusion: In treatment of intra-articular distal radius fractures in middle-aged Patients internal fixation with locking plates may be preferred to pin and plaster as the treatment of choice.

Keywords: Radius fracture, internal fixation, pin and plaster, plating, treatment

Introduction

Distal radius fractures (DRFs) are the most common fractures encountered in orthopedic practice and account for 20% of all fractures seen in the emergency room [1]. These fractures are experienced by all ages and demonstrate a bimodal distribution, with peak ages of 6 to 10 and 60 to 69 years [2-4]. In young adults, the fractures are typically the result of high-energy injuries such as motor accidents or fall from height. In contrast, most of the DRFs in the elderly occur from low-energy injuries such as fall from a standing height or on an outstretched hand [5, 6]. There are several types of classifications. AO classification categorizes distal radius fractures into 3 groups, based on whether articular surface is involved or not [7]. However, Fernandez categorizes distal radius fractures into five groups based on pathologic mechanism and the number of fractured pieces, and demonstrates the prognosis of the fracture perfectly. Types I, II, III and IV are due to bending, shearing, compressing, avulsion and high velocity forces, respectively [8]. The oldest description regarding the management of distal radius fractures goes from Edwin Smith Papyrus (5000 years ago in ancient Egypt) to Hippocrates, the father of Western medicine, and famous Abraham Colles [9-12]. After 5000 yrs non operative treatment is actually still the most used; this treatment is applied to undisplaced fractures, stable and reducible fractures but is also applied to unstable fractures in low demand patients [12-15]. Conservative treatment is indicated in stable fractures [16]. In unstable and displaced fractures treatment methods includes, pins and plaster, external fixation, K-wires, and open reduction and internal fixation with plates. The common complications that are associated with operative treatment of distal radius fractures can be technique related or not: tendon injuries, inadequate reduction or collapse, intra-articular placement of screws, nerve irritations or injuries, complex regional pain syndrome, carpal tunnel syndrome or other compression neuropathies, compartment syndrome, infections [17-19]. Late complications can be malunion, non-union carpal instability and ulno-carpal impingement, arthritis [20, 21].

Goals of treatment of distal radius intra-articular fractures are maintenance of articular surface symmetry, prevention of osteoarthritis and best functional results [22]. In selecting treatment options, balance between anatomic reduction, stable fixation, minimizing soft tissue damage and early range of motion is to be maintained. Radiographic features for acceptable reduction of the distal radius consist of radial shortening less than 5mm, radial inclination more than 15mm, palmar tilt between 15 dorsal and 20 volar and articular surface step \leq 2mm [23]. Treatment method must be determined by the fracture pattern, amount of displacement, stability of segments and articular surfaces, age and physical requirements of patients [24].

Different therapeutic methods have been proposed for these fractures; each have their own specific advantages and disadvantages. Pin and plaster is simple and common, but there are complications such as pin loosening, reduction failure, bone fracture at the site of the pin and infection. Open reduction and internal fixation (ORIF) has some advantages such as increased stability and rapid return of movement in unstable and intra-articular distal radius fractures. ORIF with LCP has good to perfect radiographic and functional results in comminuted intra-articular distal radius fractures and minimizes the number of unacceptable results [25, 26]. The complications are surgical trauma, devascularization of segments, wrist stiffness, tendon irritation or rupture and need for the plate removal. In addition, this invasive method cannot be performed everywhere [27, 28].

Patients and Methods

This is a prospective randomized study conducted from August 2016 to August 2018 at a tertiary care orthopedic trauma hospital catering for around 6,000,000 population. During this period 100 patients aged 30-60 years with Fernandez type III distal radius fractures were treated with either pin and plaster (n=50) or internal fixation with volar locking plate (n=50). The selection was randomized after obtaining informed consent. Exclusion criteria included specific diseases (malignancy, upper limb vascular disorder, multiple trauma, osteoarthritis, and rheumatoid arthritis), pathologic fracture, open fracture, concomitant fracture of the carpal bones and distal of ulna and history of ipsilateral distal radius fracture. Both groups were compared after one year. Demographic features were recorded, patients were examined and radiographs were reviewed. Grip strength was measured by means of mercury barometer. When the cuff of the mercury barometer was inflated to a fixed number, the patient was asked to compress the cuff until mercury level rises. The numbers were recorded for both hands and grip strength was calculated in percentages. Results of treatment were evaluated by MAYO wrist score. It consists of 4 parts, including pain (0 - 25), range of motion (0 - 25), grip length (0 - 25), and function (0-25).

Statistical analysis

Continuous variables were stated as mean, median and standard deviation. The comparison of continuous variables between independent variables was performed by using the Student t-test or Mann-Whitney U test in accordance with normality testing. A value of p less than 0.05 was considered statistically significant.

Results

A total of 100 patients were included in the study and all patients were followed up for a mean of 1 year. Of the 100

patients, 50 were treated with pin and plaster and 50 were treated with locking plate. There were 20 women and 30 men in the pin and plaster group and 22 women and 28 men in the locking plate group. The mean age in pin and plaster and locking plate group was 40.7 and 43.2 years respectively. The most frequent mechanism of trauma was road traffic accident in both groups. All patients were treated within 24 to 48 hours in both groups. General health, mental health, physical functioning, social functioning and energy were better in the locking plate group. Pain did not have significant difference in either group (P=0.564). The mean MAYO score was significantly higher in the locking plate group. The number of acceptable cases of articular surface step, volar tilt, ulnar variance and radial inclination in the locking plate group was significantly greater. Range of motion in flexion-extension axis was almost comparable in both groups, but supination-pronation was better in plate group. The number of high grade osteoarthritis was high in pin and plaster group. Grip power was also better in plate group. Two cases of infection at the pin site in the pin and plaster group, which responded to debridement and antibiotic therapy. Three cases of extensor tendon irritation due to exiting long screws dorsally and two cases of EPL tendon rupture in the volar locking plate group.

Table 1: Demographic Characteristics

Parameter	Pin and Plaster(n=50)	Plating(n=50)	P-value
Age(Mean)	40.7	43.2	0.289
Sex M/F	26/24	23/27	0.465
Side R/L	35/15	33/17	0.345
Mode of Trauma			0.003
RTA	28	30	
Fall	14	16	
Fall from height	8	4	

Table 2: Range of Motion, Standard Radiographic Indexes and Mayo Score in Both Treatment Groups

Variable	Groups		P-value
	Pin & plaster	Plating	
Articular step			0.001
<2mm	28	46	
>2mm	22	4	
Tilt			0.001
Acceptable	2	12	
Non-Acceptable	48	38	
Ulnar variance			0.001
<5mm	3	24	
>5mm	47	26	
Inclination			0.001
Acceptable	47	26	
Non-Acceptable	3	24	
Range of Motion			
Flexion-Extension	86.5	88.2	0.456
Supination-Pronation	90.5	75.6	0.001
Mean Mayo Score	65.5	80.8	0.001
Grip Power	95.5	80.6	0.001

Discussion

Prevalence of distal radius fractures is increasing with increase in life expectancy and osteoporosis. Several studies have been performed to determine the best treatment based on the articular surface involvement and the number of fragments. In this study, like some of previous studies [29], age and sex distribution did not have significant difference in the groups and these two variables have been controlled. Road traffic accident was most common cause of trauma in both groups. It is obvious that distal radius fracture is dominant

hand will result in more severe functional problems^[30]. In our study, dominant side was involved almost equally in both groups and this variable had been controlled as well (Table 1). In the study of Phandis^[29], the median MAYO score was greater than our study (90 versus 80.7), but better than Bahari-Kashani M *et al.*^[31]. In our study, the number of acceptable cases of articular surface step, palmar tilt, ulnar variance, radial inclination, the mean grip strength and the mean ROM of supination-pronation was better and high grade osteoarthritis was less in the locking plate method, which shows better short-term and long-term results. (Table 3)

In our study, radiographic results were significantly better in the locking plate group. Arora reported that use of ORIF method in individuals aged more than 70 resulted in better radiographic results and less deformity^[32]. In a study by Lee, 40% of patients were completely pain free after ORIF treatment^[33]. Arora stated 71% were pain free^[34]. In our study, pain was the same in both methods of internal fixation with LCP and pin and plaster.

In study of Arora^[35], overall prevalence of complications was reported 27% and the most frequent complication was irritation and rupture of flexor and extensor tendons. In his study, prevalence of irritation and rupture of extensor tendons were 3.5% and 1.7% respectively, which was almost comparable to our study.

Weil WM *et al.*^[36], demonstrated that plaster fixation often cannot preserve reduction and modify the length. In these cases, reduction will normally fail two weeks after plaster reduction^[37]. Spira reported unsuccessful results in 42% of intra-articular fractures treated with plaster as well^[38].

Conclusion

Several factors have role in selection of the therapeutic options in comminuted and intra-articular distal radius fractures. Daily requirements of patients and age have critical importance. Use of locking plates results in a perfect stable fracture reduction in osteoporotic bones. Although some studies have shown higher complications with locking plates, however it is the standard surgical treatment for intra-articular distal radius fractures. The use of locking plate in intra-articular distal radius fractures (Fernandez type III) in the elderly may be advantageous.

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