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Outcomes of Percutaneous Pinning in Treatment of Distal Radius Fractures

¹A. Sadighi, ¹M. Bazavar, ¹A. Moradi and ²B. Eftekharsadat

¹Department of Orthopedics, Tabriz University of Medical Sciences, Shohada Hospital, Tabriz, Iran

²Department of Physical Medicine and Rehabilitation,
Tabriz University of Medical Sciences, Imam Reza Hospital, Tabriz, Iran

Abstract: Distal radius fractures are among the most common bone fractures all over the world. Close reduction and fixation by percutaneous pinning is a less invasive method comparing with other open surgeries. This study aims at evaluating the functional outcome of this treatment in distal radius fractures. In this prospective study, 50 patients with distal radius fractures underwent percutaneous pinning during a 16 month period in Tabriz Shohada Hospital. Follow-up for 3 months was possible in 48 (96%) patients. Possible complications (such as infection, nonunion, pin loosening and pain), functional outcomes (including range of motion, grip and pinch strengths) and radiological outcome were documented in intervals during follow-up. Forty eight patient, 22 males and 27 females with a mean age of 47.1 ± 13.7 (19-80) years were enrolled. Local pain, infection and pin loosening were documented in 14.6, 16.7 and 2.1% of cases, respectively. Based on radiological reports, unacceptable palmar tilt, articular step, radial inclination and radial shortening were present in 6.3, 0, 2.1 and 6.3% of cases, respectively three months post-operation. The clinical outcomes according to Cooney's modification of the Green and O'Brien scheme were as excellent, good, fair and poor in 52.1, 31.3, 10.4 and 6.3% of cases, respectively. According to these results, closed reduction and percutaneous pinning of distal radius fractures is a rather successful method with minor complications.

Key words: Radius, fracture, close reduction, functional outcome, radiological outcome

INTRODUCTION

Metaphyseal fractures of distal radius are very common and comprise almost one sixth of all fracture cases in emergency department. Distal radius fractures are a common injury, particularly in the elderly population. Severity of these fractures is directly related to the bone mineral density of the patient and clinical results are dependent on this parameter as well (Grewal *et al.*, 2005; Liporace *et al.*, 2009). These fractures are limited between the radiocarpal joint up to three centimeters toward proximal portion. They are usually closed and the overlying skin is intact (Handoll *et al.*, 2007). This fracture is considered as a complex lesion; i.e., there are usually accompanying injuries in adjacent ligamentous and cartilaginous parts. So its prognosis is variable and the fracture may lead to dysfunction of upper extremity (Canale and Beaty, 2007; Buchholz *et al.*, 2009). Hence, an ideal treatment which can provide preferable anatomical reduction and fixation of fractured segments is necessary for preventing complications in the future (Souer *et al.*, 2008). Several options exist for treatment. Nonoperative management consists of closed reduction with casting. Operative treatment options include intrafocal pinning, nonbridging and bridging external fixation,

arthroscopic-assisted external fixation and various methods of open reduction internal fixation. When operative intervention is indicated, considerations include the characteristics of the fracture and the experience of the surgeon with the treatment modalities (Liporace *et al.*, 2009; Handoll and Madhok, 2009; Tsai and Paksima, 2009; Gofton and Liew, 2007). Percutaneous pinning is a modern method which is believed to be an appropriate alternate for the old approach. This involves the insertion of pins through the skin (percutaneous) to hold the bones in a proper position while they heal. In most pinning methods, wires are placed across the fracture and used to fix the fragments together (Handoll *et al.*, 2007). Although, there are a number of studies about the outcome of this approach in the literature; however, there is not any report from centers in developing countries. So this study aims at assessing the midterm consequences of percutaneous pinning in treatment of distal radius fractures in an Iranian main referral center.

MATERIALS AND METHODS

In this prospective study, 50 patients with distal radius fractures were recruited in Tabriz Shohada Teaching Hospital, Ira; during a 16 months period

between July 2008 and November 2009. These intra-or extra-articular non-comminuted fractures were type I or II according to Frykman classification (Frykman, 1967). The exclusion criteria were child patients, open fractures, comminuted intra-articular fractures, fractures with volar deviation (Smith's type), previous fracture in the region and presence of simultaneous neurological or vascular lesions or other fractures in upper extremities. The Crenshaw technique was employed for percutaneous pinning (Canale and Beaty, 2007). Under brachial plexus block, the fracture reduced by manual traction, aiming to restore the normal radial and volar tilt of the distal radial epiphysis. The elbow was fixed at 90 degree flexion. The quality of the reduction is then checked with fluoroscopy in A-P and lateral projections, by rotating the C-arm around the wrist while the patient's hand is held steadily. Then three 1.5 mm diameter K-wires were applied for osteosynthesis. These K-wires were placed crossed-over, 2 in radial side and 1 in ulnar side. At the end, the K-wires were bent and put under the skin. Quality of reduction and fixation of fracture was rechecked by radiography after surgery. Follow-up was done on weeks 1, 3, 6 and 12 post-operation. At the end of week 1 wrist support was administered and physiotherapy of fingers, elbow and shoulder was started. Control radiographs were taken on weeks 3 and 6 post-operation. Clinical results were evaluated in the follow-up period according to Cooney's modification of the Green and O'Brien scheme (Cooney *et al.*, 1980; Green and O'Brien, 1978) (Table 1). All the patients were visited by a physiotherapist on week 12 after operation and bilateral grip and pinch strengths as well as Range of Motion (ROM) of the wrists were reported. All the results were presented as fraction of that parameter in the operated side divided by that in non-affected extremity. Possible complications were looked for, such as pain (by visual analogue scale, VAS), infection, pin loosening, mal- or non-union and radiological assessment results (including palmar tilt, articular step, radial inclination and radial shortening). Statistical evaluation was made using SPSS for Windows V 15.0 (SPSS Inc., IL, USA). Data are shown as mean±standard deviation or frequency (percentage).

RESULTS

Fifty patients with unilateral fractures of distal radius were enrolled. Follow-up was possible in 48 (96%) patients. The mean age was 47.1±13.7 (19-80) years including 13 (27.1%) between 15 and 39 years, 28 (58.3%) between 40 and 59 years and 7 (14.6%) patients 60 years old or over. Twenty two (45.8%) patients were male and 26 (54.2%) were female. In 26 (54.2%) patients the fracture

Table 1: Clinical scoring system of Green and O'Brien (1978) modified by Cooney *et al.* (1980) score

Score	Findings
Pain	
25	None
20	Mild, occasional
15	Moderate, tolerable
0	Severe or intolerable
Functional status	
25	Returned to regular employment
20	Restricted employment
15	Able to work but unemployed
0	Unable to work because of pain
Range of motion	
25	Full
15	75-99% of normal
10	50-74% of normal
5	25-49% of normal
0	Less than 25% of normal
Grip strength	
25	120° or more
15	91-119°
10	61-90°
5	31-60°
0	30° or less
Or evaluating dorsiflexion-palmar flexion arc of injured hand	
25	
15	75-99% of normal
10	50-74% of normal
5	25-49% of normal
0	0-24% of normal
Final result	
90-100	Excellent
80-89	Good
65-79	Fair
<65	Poor

was on the right side and in 22 (45.8%) patients on the left. In 1 (2.1%) patients the joint was involved. Seven (14.6%) patients complained from pain in the site during the follow-up period including 3 (6.3%) cases on week 3 (7, 8 and 8 based on the VAS), 2 (4.2%) cases on week 6 (3 and 4 based on the VAS) and 2 (4.2%) cases on week 12 (3 and 4 based on the VAS) after operation. Infection of the site was documented in 8 (16.7%) cases during the follow-up period including 5 (10.4%) cases on week 3 and 3 (6.3%) cases on week 6 after operation. All the cases with infection on week 3 were treated by intravenous antibiotics and infection on week 6 was resolved after extracting the pins. Pin loosening was documented in 1 (2.1%) case on week 3 post-operation. The pin extracted in this patients and short-arm cast was used. There was no case with non-union or digital stiffness. The results of functional and radiological evaluations are shown in Table 2. Clinical results at the end of follow-up period according to Cooney's modification of the Green and O'Brien scheme were as follows: excellent in 25 patients, good in 15 patients, fair in 5 patients and poor in 3 patients. Percentages of these results are shown in Fig. 1.

Table 2: Results of functional and radiological evaluations in operated and intact extremities

Parameter	Time (post-operation)	Operated side	Intact side	Operated side/intact side (%)
Grip strength score	Week 3	14.9±7.6	28.6±17.2	52.1
	Week 6	14.6±8.1	27.5±21.2	53.1
	Week 12	14.4±7.9	27.0±21.4	51.4
Pinch strength score	Week 3	9.8±4.1	13.9±4.8	70.5
	Week 6	9.5±4.3	16.2±18.0	58.6
	Week 12	9.5±4.1	16.0±18.4	64.1
Range of motion (degree)				
Flexion	Week 12	36.1±17.1	61.8±24.9	55.5
Extension	Week 12	37.1±12.7	51.2±21.5	70.1
Pronation	Week 12	71.6±25.3	83.2±19.8	86.1
Supination	Week 12	68.6±22.8	82.9±18.0	27.8
Radial deviation	Week 12	13.9±10.6	27.5±19.0	50.7
Ulnar deviation	Week 12	29.8±16.8	36.6±18.1	76.1
Abnormal radiological findings				
Palmar tilt	Week 12	3 (6.3)	-	-
Articular step	Week 12	0 (0)	-	-
Radial inclination	Week 12	1 (2.1)	-	-
Radial shortness	Week 12	3 (6.3)	-	-

Data are shown as mean±standard deviation and frequency (percentage)

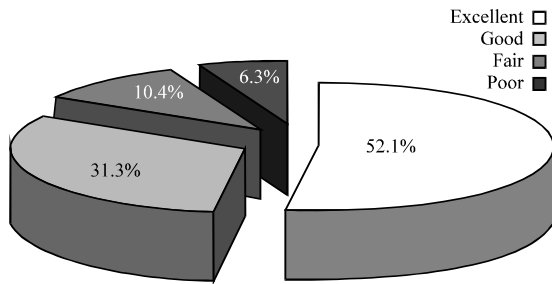


Fig. 1: Percentage of clinical results at the end of follow-up period according to Cooney's modification of the Green and O'Brien scheme

DISCUSSION

In this study the functional consequences and possible complications of percutaneous pinning in treatment of distal radius fractures were assessed. The ROM of the treated extremity ranged from 27.8% (for supination) to 86.1% (for pronation) of the intact limb three months post-operation. Pain and infection in the operated location and loosening of pins were documented in 14.6, 16.7 and 2.1% of the patients, respectively. All these complications were resolved by noninvasive measures. No case of nonunion or digital stiffness was encountered during the follow-up period. Hayes *et al.* (2008) followed up 358 New Zealandian patients with distal radius fractures after percutaneous pinning for 358 days. Infection, pain and nonunion were reported in 27, 4 and 0.6% of the cases, respectively. Comparing with

present results, the rates of infection and nonunion is much more in the mentioned study and frequency of cases with pain is lower. It should be reminded that there are various methods in reporting pain and this possible may affect the final report. In another series by Rosati *et al.* (2006) in Italy, 106 patients with distal radius fractures were operated by percutaneous pinning approach. There was no case with vascular, neurological or tendon injuries in this study. Mild infection was reported in 1.2% of cases and pain was reported in 5.6% of patients which all resolved by noninvasive treatments. The results are better in this study comparing with ours. However, the complications in current series were not serious in majority and as mentioned earlier all recovered by simple therapies. Rizzo *et al.* (2008) evaluated 41 American patients with distal radius fractures after treatment by percutaneous pinning method for an average of 33 months post-operation. Pain, infection and digital stiffness were reported in 2.1, 2 and 1% of patients. The ratio of grip strength in the operated side to that in the intact side was 90% at the end of follow-up. Beside the complications rate, the functional outcome also seems to be better in this study comparing with our. This heterogeneity of results in various studies might be mainly due to different follow-up period. Further studies with longer follow-ups may be recommended in this regard. Hargreaves *et al.* (2004) showed that although the infection rate is rather high in this method of operation, they are usually mild and could be managed by administration of antibiotics or extraction of pins. In a study by Chen *et al.* (2008) in Taiwan on 54 patients, there was not any case with nonunion during a one-year follow-up. Present result is also similar in this regard. Baig *et al.* (2008) assesses 33 Pakistani patients in this regard. Reduction was lost in 6.1% of patients in which cast was used and the final results were excellent. Infection and digital stiffness were reported in 3 and 27.2% of cases, respectively. The rate of digital stiffness is higher in this study comparing with that in present study. It seems that the sample size is a limiting factor in the mentioned study. Summing up, the results of different reports in regard to the rate of complications and functional outcome are very similar with minor differences. Present results are also in conformity with others and in acceptable range. The radiological assessments at the end of follow-up also showed significant outcomes in present study with abnormal palmar tilt, articular step, radial inclination and radial shortness only in 6.3, 0, 2.1 and 6.3% of patients, respectively. In the study by Hayes *et al.* (2008), reduced radial length was reported in 32% of cases. Comparing the results, limb shortening rate was

much less than that in Hayes's study. It should be noticed that the reported rate in the mentioned study was about any amount of limb shortening. These radiological findings were also in acceptable ranges in the studies performed by Baig *et al.* (2008), Walton *et al.* (2001) and Rosati *et al.* (2006). In current study, the clinical outcomes at the end of follow-up period according to Cooney's modification of the Green and O'Brien scheme were as excellent, good, fair and poor in 52.1, 31.3, 10.4 and 6.3% of cases, respectively. Based on the same grading scheme, Rosati *et al.* (2006) reported the final outcomes as follows: excellent, good, fair and poor in 53.7, 26.5, 11.3 and 8.5% of cases, respectively. As seen, the results of the two studies are very similar in this regard. In conclusion, this study showed that the percutaneous pinning in treatment of distal radius fracture is relatively successful with minor complications. These findings are in line with the previous reports from the Western countries. As partly emphasized earlier, present differences might be justified by differences in the studied populations' characteristics (such as gender, age and severity of lesions), level of surgeons' skill and post-operative facilities and follow-up period (Rosati *et al.*, 2006; Gofton and Liew, 2007).

CONCLUSION

The ROM of the treated extremity ranged from 27.8% (for supination) to 86.1% (for pronation) of the intact limb 3 months post-operation. Pain and infection in operated location and loosening of pins were documented in 14.6, 16.7 and 2.1% of the patients, respectively. All these complications were resolved by noninvasive measures. No case of nonunion or digital stiffness was documented. Abnormal palmar tilt, articular step, radial inclination and radial shortening in radiological assessment were present in 6.3, 0, 2.1 and 6.3% of patients, respectively. Further studies in similar centers with longer follow-up periods, as well as versus other methods employed for treatment of distal radius fractures are recommended.

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