



ISSN: 2395-1958
IJOS 2019; 5(1): 186-189
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www.orthopaper.com
Received: 14-11-2018
Accepted: 16-12-2018

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Results of technique of intrafocal pinning in the management of distal radius fractures

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DOI: <https://doi.org/10.22271/ortho.2019.v5.i1d.35>

Abstract

Background and Objectives: Fractures of distal end of the radius are the most common fractures that orthopedic surgeons have to treat. Range of fracture extends from simple extraarticular to highly comminuted intraarticular fractures. Our objective was to assess the outcome of intra focal pinning in distal radius fractures in terms of functional recovery and radiological union and to assess the complications associated with the procedure.

Materials and Methods: The present prospective study was conducted between January 2016 and September 2017. 30 patients were enrolled for the study and follow up for a period of 6 months. Closed reduction and percutaneous pinning with K wire were done. The radiological parameters were assessed for pre-reduction, post reduction, 4 weeks, 3 months and at 6 months. The data from the radiological parameters was analyzed using students t-test, Bonferroni comparison test and chi-square test. The values were normally distributed (normality test $P=0.3$) and significance was assessed using a paired t-test. The statistical significance was defined as $p<0.01$.

Results: Mean age was 42.03 years with 19 male and 11 female patients. 18(60%) were due to RTA and 10 (33.3%) were due to fall. Pin tract infection was seen in 2 patients, K-wire loosening was encountered in 1 patient, Loss of reduction in 1 patient, Radiocarpal arthritis in 2 patients. The radiological parameters were assessed for pre-reduction, post reduction, 4weeks and at 3 months. There was a significant difference in all the three parameters i.e. volar tilt, radial length and radial inclination between both the groups at the end of 3 months.

Conclusion: From our study, we conclude that percutaneous pinning technique is a simple, cheap, minimally invasive and effective method for the treatment of unstable extra articular distal radius fractures, with good functional results.

Keywords: Distal radius, percutaneous pinning, closed reduction

Introduction

Fractures of distal end of the radius are the most common fractures that orthopedic surgeons have to treat. Range of fracture extends from simple extraarticular to highly comminuted intraarticular fractures. Nearly 16% of all fractures that are treated in emergency departments involve the distal end of the radius [1]. Many fractures of the distal end of radius are in fact relatively uncomplicated and are effectively treated with closed reduction and immobilization in a plaster cast. However, fractures that are either unstable and/or involve the articular surfaces can jeopardize the integrity of the articular congruence and/or the kinematics of these articulations [1]. Some of these fractures are caused by severe high energy trauma, resulting in intra-articular involvement and comminution. Treatment of such injuries is difficult. These fractures often are unstable, are difficult to reduce anatomically, and are associated with a high prevalence of complications of post-traumatic osteoarthritis. Intrafocal pinning is defined as the insertion of pins into the fracture site that can be used to lever the displaced distal fragment into position. Once adequate reduction is achieved, the pins are driven into the metaphysis of the proximal fragment of the radius. The pins act to buttress the distal fragments while maintaining fracture reduction. Distal radius fractures with significant comminution may also require supplemental skeletal stabilization to preserve the length of the radius. Supplemental skeletal stabilization includes external fixation and internal spanning bridge plate techniques [2]. Generically the wires function in two ways, either to maintain reduction between two fragments (interfocal pinning) or else to buttress the distal fragments, thereby preventing

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displacement as well as shortening (intrafocal pinning). The basic benefit of this technique is it is more stable fracture than conservative casts. Also preferred in elderly patient with reduced bone quality^[3]. When the dorsal angle is greater than 20, radial inclination is below 10, and radial shortening is more than 6mm, there are definite functional consequences^[4].

Materials and methods

The present prospective study conducted between January 2016 and September 2017. 30 patients were enrolled for the study and follow up for a period of 6 months. Adults with extra-articular fractures, Unstable fractures, Radiological-significant deformity in the presence of comminution of the dorsal fragment, Failure to maintain reduction of the fracture post reduction while the patient was still under general anesthesia fracture that displaced in cast, were included in the study.

Multiple trauma or other injuries, Open fractures, Neurovascular injuries, associated musculoskeletal injuries to same arm, Patients who lost for follow up, Patients having dementia and psychiatric illness were excluded from the study.

Closed reduction and percutaneous pinning with K wire are done with patient in supine position. After adequate anesthesia is achieved, the hand was prepared and draped, a closed reduction is performed. Closed reduction is assessed and confirmed under C-arm imaging in both anterior-posterior and lateral planes. A small incision is made at the site of pin insertion, and the tissue protector for the drill is used to prevent injury to the sensory branches of the radial nerve. Kirschner wires are used as the intrafocal pins. The pins required to correct the radial inclination are driven into the radial cortex. The pins are then levered to redirect them proximally before driving them across the opposite cortex in both the posterior-anterior plane and in the lateral plane. Dorsal rotation is corrected. Three or four pins are usually required. Loss of radial inclination and/or radial translation are corrected with one to three Kirschner wires using one pin placed between the first and second compartment, one just dorsal to the second compartment, and one placed in the

Lister's tubercle, taking care to avoid the extensor pollicis longus. The Kirschner wires are cut under the skin. A short arm cast was applied post operatively in each case. The patients were discharged home when their symptoms allowed finger free movements. They were seen at outpatient clinic at 4 weeks, when the cast was changed, to remove the wires and for check radiographs. They were subsequently referred to physiotherapist.

Standard antero-posterior and lateral radiographs of the wrist were taken with forearm in neutral rotation. The volar tilt of the distal radius expressed as number of degrees from neutral position, the radial length and radial inclination were then measured. The radiological parameters were assessed for pre-reduction, post reduction, 4 weeks, 3 months and at 6 months. The wires and plaster were removed at 4 weeks. The functional outcome was assessed. The range of movement of the wrist and forearm were measured and compared to the normal contralateral side. The data from the radiological parameters was analyzed using students t-test, Bonferroni comparison test and chi-square test. The values were normally distributed (normality test $P= 0.3$) and significance was assessed using a paired t-test. The statistical significance was defined as $p<0.01$.

Results and discussion

The age of the patients ranged from 21 to 67 years with a mean age of 42.03 years. The maximum incidence of the injury was observed during 3rd and 2nd decade of life. Out of 30 patients, 19 patients were male and 11 patients were female. So, the incidence was significantly higher in male. The male and female ratio is 2:1. Right wrist was involved in 23 cases while the left wrist was involved in 07 cases. 18 (60%) cases attained fracture due to motor vehicle accident, 10 (33.3%) cases attained fracture due to fall and 2 (6.6%) attained fracture due to other causes. MVA is the most common mode of injury followed by fall with an out-stretched hand. Pin tract infection was seen in 2 patients, K-wire loosening was encountered in 1 patient, Loss of reduction in 1 patient, Radiocarpal arthritis in 2 patients.

Table 1: Mean Radiological Measurements: Table 1: Radial Length

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	1.258	.299	HS
4th week K- wiring with closed reduction	2.288	.308	HS
3 months K- wiring with closed reduction	1.936	.287	HS

Table 2: Radial Inclination

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	1.911	.213	HS
4th week K- wiring with closed reduction	3.557	.185	HS
3 months K- wiring with closed reduction	2.991	.216	HS

Table 3: Volar Tilt

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	-3.616	.370	HS
4th week K- wiring with closed reduction	-5.636	.419	HS
3 months K- wiring with closed reduction	-5.449	.414	HS

The radiological parameters were assessed for pre-reduction, post reduction, 4weeks and at 3 months. There was a significant difference in all the three parameters i.e. volar tilt, radial length and radial inclination between both the groups at the end of 3 months.

It has been traditionally taught that fractures of lower end of the radius are more common in postmenopausal females. In young males it is due to high energy trauma and in elderly females it is due to insufficiency fracture. With a greater number of vehicles on road and increased industrialization,

number of patients sustaining high energy trauma has increased.

While anatomical reduction can usually be achieved by closed manipulation, there is still no agreement as to the most appropriate way of maintaining fractures. Although several studies on the use of percutaneous k-wires for the stabilization of distal radius fractures have been published [5, 6-11], their use in elderly remain uncertain as seen by McQueen [12]. Studies by Clancey [7], Atkinson [8], Shankar [9] and Walton [13] 45 have included a heterogenous group of fractures of different age groups and different regimen of treatment. Although good results have been claimed, controlled trials are lacking. Stoffelen and Broos [56] conducted a prospective randomized trial comparing closed reduction with intrafocal pinning for extra-articular fracture. They found no difference in outcome between groups.

The movements that are present at the wrist are palmar flexion, dorsiflexion, ulnar deviation, radial deviation. The movement that are present at distal radioulnar joint are supination and pronation. Since intraarticular fractures can affect the range of motion at the joint their restoration is important to achieve good results. Physiotherapy and rehabilitation are required and have to be planned carefully. In the present study the average of movements at the affected wrist are palmar flexion 43.7⁰, dorsiflexion 54⁰, ulnar deviation 21.1⁰, radial deviation 13.1⁰, supination 72.6⁰ and pronation 71.6⁰.

The range of motion is slightly lesser but are comparable to other studies. Supination and pronation seem to be affected less. This probably is due to the result of less education and less vigorous physiotherapy in Indian patients and our series included mostly young adults with high energy trauma and intraarticular involvement.

In any surgical procedure there are chances of complications, fractures of lower end of the radius are not an exception. The complications can be early and late complications. The early complications include loss of reduction, median nerve injury, damage to superficial branch of radial nerve, tendon injuries. The late complications include radiocarpal arthritis, distal radioulnar joint dissociation and arthrosis, loss of reduction and secondary deformity, extensor tendon rupture.

Complications was seen in 6(20%) patients. In the present series 2(6%) patient had pin tract infection which was controlled with appropriate antibiotics based on culture and sensitivity report. There was 1 (3%) case of loosening of K wire. 1(3%) patient who initially had fixation with K wire there was loss of reduction and was repeated with external fixation and K wire augmentation 4 days later. 2(6%) patients developed radiocarpal arthritis grade 1 as described by Knirk and Jupite [14].

None of the patients had median nerve complications fortunately. The complications in our series is higher than Kapoor series and is lower than Bradway and Jupiter series. Bradway and Jupiter had longer followed up and included late complications which is not seen in our case and hence lower complication rate. Long term follow up is required to assess late complications.

We considered immobilization of fracture for 4 weeks to be adequate and no significant displacement occurred in between. We found statistically significant differences in radiological parameters between the two groups which was similar to the results found by Azzopardi [15]. But standardizing lateral views of wrist can be difficult, and the magnitude of difference found were within errors of measurement. In our study we assessed functional outcome by

Quick DASH unlike other studies where Mayo wrist score by Azzopardi [15] and ADL (activities of daily living) by Wong [16] were used. The improvement in functional outcome and range of movement in patients treated by supplementary wires was not statistically significant. This supports opinion of McQueen [12] that k-wires do not gain sufficient purchase in osteopenic bone in elderly patients to maintain anatomical reduction of fracture and to improve function.

Conclusion

From our study, we conclude that percutaneous pinning technique is a simple, cheap, minimally invasive and effective method for the treatment of unstable extra articular distal radius fractures, with good functional results. It should not be used alone for patients with severe osteopenia, marked dorsal radial comminution, and an associated distal metadiaphyseal ulna fracture and in patients with both volar and dorsal comminution of the distal radius.

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