

Results of Distal Radial Fractures Treated by Intra-focal Pin Fixation

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Abstract

Introduction: Kapandji described intra-focal pin fixation of distal radial fracture in which the pins pass through the fracture line and anchor to the far cortex. These pins aid reduction of the fracture and maintain reduction by buttressing the distal fragments. **Materials and Methods:** Between January 1996 to December 1997, 186 distal radial fractures were treated with intra-focal pin fixation. One hundred and seventy-seven patients were available for review after an average follow-up of 30.8 months, ranging from 24 to 36 months. In 133 fractures, a trans-styloid pin was inserted to supplement the intra-focal pin fixation. The fractures were classified according to AO classification into 126 A2, 9 A3, 39 C1 and 3 C2. The anatomical results were evaluated by using Sarmento's criteria and the functional results by Mayo wrist score. **Results:** Radiological union was achieved in 123 fractures by 2 months, 51 fractures by 3 months and 3 fractures by 4 months. Anatomical results were excellent in 46 fractures, good in 118, fair in 10 and poor in 3. Functional results were excellent in 54 cases, good in 109, fair in 9 and poor in 5. Complications included 2 cases of reflex sympathetic dystrophy and 2 cases of rupture extensor pollicis longus. **Conclusion:** Intra-focal pinning with or without supplementation of a trans-styloid pin is an effective method for treating unstable fractures of the distal radius.

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Key words: AO classification, Intra-focal pin, Kapandji technique, Mayo wrist score, Trans-styloid pin

Introduction

Unstable fractures of the distal radius remain a challenge to orthopaedic surgeons. Unsatisfactory results are often associated with significant malunion. Many methods are aimed to maintain radial height, radial and palmar inclinations and articular congruity following reduction. Kapandji described intra-focal pin fixation of distal radial fracture in 1976. The pins pass through the fracture line and anchor to the far cortex. The radial and dorsal pins aid reduction of the fracture and maintain reduction by buttressing the distal fragments. Volar intra-focal pin is used when there is volar displacement of the distal fragments.

Osteoporotic bones and fractures with cortical comminution are associated with higher chance of loss of reduction after intra-focal pin fixation. Fractures with anterior over reduction after intra-focal pin fixation and intra-articular fractures with displaced radial styloid fragment are unstable. In this study, addition of a trans-styloid pin is used in these fractures to increase the stability of intra-focal pin fixation. Stable fixation of the distal radius fractures allows early mobilisation of the wrist and hand. This article reviewed the results of intra-focal pin fixation of the distal radius fractures with or without a trans-styloid pin.

Materials and Methods

Between January 1996 to December 1997, 186 distal radial fractures were treated with intra-focal pins with or without a trans-styloid pin. One hundred and seventy-seven patients were available for review after an average follow-up period of 30.8 months, ranging from 24 to 36 months. The average age of the patients at the time of operation was 47.7 years with a range of 16 to 84 years. There were 91 males and 86 females. Ninety-five fractures involved the right hand and 82 fractures involved the left hand. One hundred and seven patients were unemployed and 70 patients were employed. There were 126 type A2, 9 A3, 39 C1 and 3 C2 fractures. One hundred and thirteen fractures were treated on the day of injury (9 A3, 39 C1 and 3 C2 unstable fractures and 62 A2 fractures which failed to achieve satisfactory reduction following manipulation). Fifty-seven A2 fractures were treated at 1 week and 7 A2 fractures at 3-week post injury because they re-displaced in the cast after initial successful manipulation and reduction. All fractures were fixed with intra-focal pins (1 radial and 1 dorsal pins in 90 fractures and 1 radial and 2 dorsal pins in 87 fractures). Initial volar displacement of distal fragments was also seen in 8 cases and additional volar intra-focal pinning was used (1 volar pin in 3 cases and 2 volar pins in

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5 cases). An additional trans-styloid pin was used in selected cases (133 cases). The indications were elderly patients with osteopenic bone (77 cases), extra-articular fractures with cortical comminution (9 A3 fractures), fractures with anterior over reduction after intra-focal pin fixation (5 cases) and intra-articular fractures with displaced radial styloid fragment (39 C1 and 3 C2 fractures).

Operative Technique

The entry points for the radial pin (between first and second dorsal extensor compartments), the dorso-radial pin (between third and fourth dorsal extensor compartments) and the dorso-ulnar pin (between fourth and fifth compartments) were marked on the skin at the fracture site. Small longitudinal stab incision was made at the entry point for the dorso-radial pin. Small artery forceps was used to dissect the tissue down to the fracture site. Care was taken to retract the tendons, sensory nerves and soft tissues away. A free 1.6-mm strong arthrodesis wire was initially placed from the dorsal side of the fracture directly into and parallel to the fracture site. Halfway passed the fracture, the wire was then directed obliquely 45° in a proximal direction till its end hit the volar cortex of the proximal bone. The exposed end of the wire was then connected to a drill. The other end of the wire was driven across the volar cortex for 3 to 5 mm. A similar procedure was done for insertion of the dorso-ulnar pin. The radial pin was inserted from the radial aspect of the fracture and anchor to the ulnar cortex of the proximal bone.

The entry points for the radio-volar pin (radial to the flexor carpi radialis) and the radio-ulnar pin (ulnar to the flexor carpi ulnaris) were marked on the skin at the fracture site. The pin was inserted from the volar aspect of the fracture and anchored to the dorsal cortex of the proximal bone.

A trans-styloid pin was inserted through a stab incision over the tip of the styloid, the pin was driven through the styloid process, the fracture site and into the ulnar cortex of the proximal bone.

Fracture reduction with regards to restoration of radial height, radial inclination and palmar tilt as well as the position of the pins were verified using the image intensifier. The pins were bent, cut and their ends buried under the skin.

Postoperative Rehabilitation

Gentle active and passive range of finger, wrist, forearm, elbow and shoulder motion exercises began on the first postoperative day. The patient was instructed to keep the hand elevated to prevent oedema. Carrying of any weight was prohibited till radiological union had occurred. The pins were removed when radiological union occurred.

Muscle strengthening exercises began 1 day after removal of the pins.

Assessment of Results

The patients were reviewed at an average follow-up of 30.8 months with an interview and a physical examination. Antero-posterior and lateral radiographs of the wrist were taken. The functional results were rated with Mayo wrist score.¹ For those patients who were unemployed, assessment of the functional status referred to return to household duties, recreation or leisure activities. The preoperative, immediate postoperative and the latest anteroposterior and lateral radiographs (Fig. 1) were compared and the anatomic results were rated with Sarmiento's criteria.² The radial height, radial inclination and palmar tilt were measured.

Results

Radiological union was seen in 123 fractures by 2 months, in 51 fractures by 3 months and in 3 fractures by 4 months. According to the anatomic score by Sarmiento et al² in 1980, excellent results were noted in 46, good in 118,

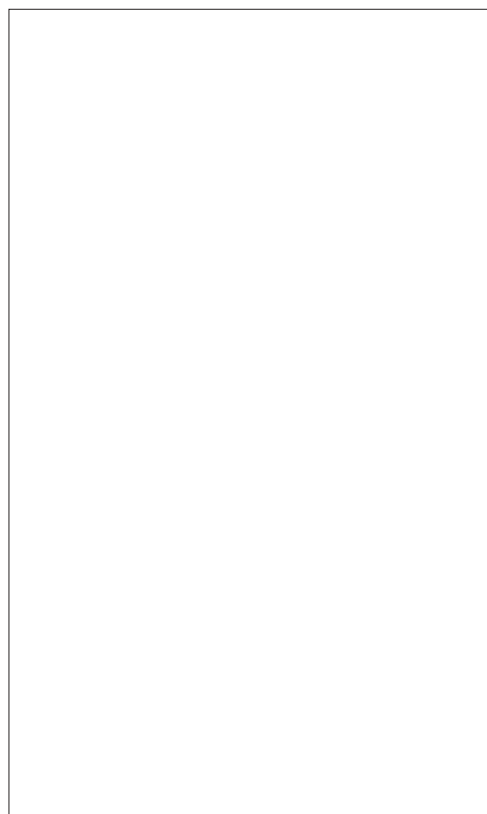


Fig. 1. The preoperative anteroposterior (A) and lateral (B) radiographs show a AO type C2 fractures. The immediate anteroposterior (C) and lateral (D) radiographs show restoration of the radial height, radial inclination and palmar tilt. A trans-styloid pin was used because of dorsal cortical comminution. At 28 months follow-up, the anteroposterior (E) and lateral (F) radiographs show no change of radial height, radial inclination and palmar tilt.

fair in 10 and poor in 3. All cases of poor and fair anatomic results were seen in subjects more than 65 years old and their bones were osteoporotic. The results of radial height, radial inclination and palmar tilt are shown in Table I.

TABLE I: THE RESULTS OF RADIAL HEIGHT, RADIAL INCLINATION AND PALMAR TILT

	Radial height Mean (SD)	Radial inclination Mean (SD)	Palmar tilt Mean (SD)
Prepinning	5.7 mm (3.7)	7.5° (7.0)	-9.1° (10.6)
Postpinning	11.0 mm (2.5)	21.1° (2.9)	9.7° (5.3)
Follow-up	10.3 mm (4.5)	20.6° (4.7)	6.3° (4.4)

Using Mayo wrist score,¹ the functional results were rated excellent in 54 cases, good in 109, fair in 9 and poor in 5. Poor functional results were seen in 2 cases of reflex sympathetic dystrophy, 2 cases of rupture of extensor tendon and 1 case of loss of reduction with poor anatomic result. Fair functional results were seen in 3 cases of loss of reduction (fair anatomic result in 1 and poor anatomic result in 2). The other cases of fair radiological results were having good functional results in 7 and excellent results in 2 cases. All patients returned to work, pre-injury household duties or recreation and leisure activities after an average of 66.8 days (standard deviation was 15.3).

Discussion

In the treatment of distal radial fractures, the aim is to restore radial inclination to 22°; palmar tilt to 11° and radial length to 12 mm.³ Trumble et al⁴ in 1998 found that restoration of the radial length has the most significant effect on range of motion and grip strength. In 1976, Kapandji described a method of using limited open placement of buttressing Kirschner wires (one radial pin and one dorso-radial pin) to fix unstable extra-articular fractures of distal radius in young patients, which he termed intra-focal pinning. Subsequently, he recommended an addition of a third pin inserting dorso-ulnarly to provide further support. With addition of a pin, he extended the use of intra-focal pin to fractures with multiple fragments. Anteriorly displaced distal radial fractures are treated by intra-focal pinning, with the pins inserted through an anterior approach.

Loss of reduction with inferior radiological result is commonly seen in elderly patients.^{5,6} Dowdy et al⁵ in 1996 reported that there was a trend for patients with osteopenic bone to lose reduction after the fixation and patients older than 65 years of age had significant inferior radiological results. Greeting and Bishop⁶ in 1993 reported the Mayo experience of 24 procedures. Good and excellent radiological results were achieved in 79% of patients less than

65 years of age. Only 60% good and excellent radiological results were seen in subjects more than 65 years of age. Seventy per cent of patients less than 65 years of age and 100% of patients more than 65 years of age obtained good or excellent clinical results, indicating that the technique provides acceptable clinical results in elderly patients despite some loss of reduction after pinning. Another cause of loss of reduction is fracture with cortical comminution. Trumble et al⁴ recommended external fixator to be used in addition to intra-focal pinning fixation of distal radial fractures with comminution of both volar and dorsal sides of radial metaphysis in young patients. They also recommended external fixator to be used in addition to intra-focal pinning fixation of distal radial fractures with comminution of one side of radial metaphysis in older patients.

Anterior over reduction is another cause of poor reduction.^{7,8} Milliez et al⁷ in 1996 reported the use of intra-focal pinning in 58 distal radial fractures and noted 14% of anterior carpal translation which led to anterior instability. Benoist and Freeland⁸ recommended that routine stress views after pinning could yield information concerning carpal instability, palmar instability and the need for bone grafting.

In this study, intra-focal pin fixation alone provided stable fixation for extra-articular fractures without comminution in 44 subjects with good bone quality. A trans-styloid pin was added in selected 133 cases. The indications were elderly patients with osteopenic bone, fractures with cortical comminution, fractures with anterior over reduction after intra-focal pin and intra-articular fractures with displaced radial styloid fragment. All the patients were allowed early postoperative mobilisation. Good and excellent functional results were seen in 163 (92.1%) cases and fair and poor results in 14 (7.9%) cases. Good and excellent anatomic results were seen in 164 (92.7%) and fair and poor in 13 (7.3%).

Complications included 2 cases of reflex sympathetic dystrophy and 2 cases of rupture extensor pollicis longus. Thirteen patients had fair and poor anatomical results. They were over 65 years old and their bones were osteoporotic. Their functional results were excellent and good in 9 (69.2%) and fair and poor in 4 (30.8%). Greeting and Bishop⁶ reported the Mayo experience and concluded that intra-focal pin fixation provided acceptable clinical results in elderly patients despite some loss of reduction after pinning.

Nonnenmacher and Kempf⁹ reported a series of 350 procedures in 1988. Patients with more extensive comminuted or intra-articular fractures did poorer. Complications included distal radio-ulnar instability (one case), reflex sympathetic dystrophy (8%), the need for

early pin removal (7%), radial sensory nerve irritation (6%), ulnar neuropathy of the wrist (one patient), extensor tendonitis (2%) with 2 cases of extensor tendon rupture and a 14% incidence of displacement of fragments after pinning.

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