Unstable extra-articular fractures of the distal radius

A PROSPECTIVE, RANDOMISED STUDY OF IMMOBILISATION IN A CAST VERSUS SUPPLEMENTARY PERCUTANEOUS PINNING

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We performed a prospective, randomised study on 57 patients older than 60 years of age with unstable, extra-articular fractures of the distal radius to compare the outcome of immobilisation in a cast alone with that using supplementary, percutaneous pinning.

Patients treated by percutaneous wires had a statistically significant improvement in dorsal angulation (mean 7°), radial length (mean 3 mm) and radial inclination (mean 3 mm) at one year. However, there was no significant difference in functional outcome in terms of pain, range of movement, grip strength, activities of daily living and the SF-36 score except for an improved range of movement in ulnar deviation in the percutaneous wire group. One patient developed a pin-track infection which required removal of the wires at two weeks.

We conclude that percutaneous pinning of unstable, extra-articular fractures of the distal radius provides only a marginal improvement in the radiological parameters compared with immobilisation in a cast alone. This does not correlate with an improved functional outcome in a low-demand, elderly population.

In 1814, Colles' described a fracture of the distal radius. Nearly two centuries later, there is still no consensus regarding the description, management and assessment of the outcomes of such injuries. This has made it difficult to evaluate the various methods of treatment.

In his original article Colles noted that “one consolation remains, that the limb at some remote period will again enjoy perfect freedom in all its motions and be completely exempt from pain”. However, it is clear that a proportion of unstable fractures redisplace after closed reduction and external splintage alone, resulting in a poor functional outcome.

Displaced fractures of the distal radius are considered to be unstable when alignment cannot be maintained in a forearm cast after closed reduction, but this definition applies retrospectively. Previous studies have attempted to identify risk factors for instability. These include the pattern of the fracture (dorsal comminution beyond the midaxial plane of the radius, intra-articular fracture, associated ulnar fracture), the severity of primary displacement (dorsal angulation > 20°, radial shortening > 5 mm), and patient factors (age > 60 years, quality of the bone). Management must also take into account other local factors such as the inherent stability after reduction and the severity of soft-tissue injuries, and those associated with the individual patient such as lifestyle, associated medical conditions and compliance.

Various methods of preventing or minimising the loss of reduction of unstable fractures of the distal radius have been described. These include percutaneous pinning of the distal fragment, immobilisation with pins incorporated in the plaster, external skeletal fixation, limited open reduction with or without bone grafting or bone substitutes and extensive open reduction and internal fixation. Percutaneous pinning has been recommended as a simple way of providing additional stability to immobilisation in a cast in unstable, extra-articular fractures of the distal radius in which anatomical reduction is obtainable. In elderly, osteoporotic patients and in severely comminuted fractures the technique has less favourable results and is therefore considered to be inappropriate.

However, it is still recommended by some authors because it is simple to use and much less intrusive than other methods such as external fixation.

We have conducted a prospective, randomised trial to compare immobilisation in a cast alone with supplementary, percutaneous pinning to maintain the reduction of unstable, extra-articular fractures of the distal radius after closed reduction in an elderly population.
Table I. Details of both groups of patients

<table>
<thead>
<tr>
<th></th>
<th>Closed reduction</th>
<th>Percutaneous pinning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Mean (SD) age in yrs</td>
<td>71 (9)</td>
<td>72 (8)</td>
</tr>
<tr>
<td>Men:women</td>
<td>2:25</td>
<td>4:23</td>
</tr>
<tr>
<td>Dominant side injury</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Non-dominant side injury</td>
<td>15</td>
<td>17</td>
</tr>
</tbody>
</table>

Table II. Assessment of activities of daily living (score 0, unable to perform; 1, perform with difficulty; and 2, normal)

<table>
<thead>
<tr>
<th></th>
<th>Unilateral</th>
<th>Bilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Picking up a plate</td>
<td>Remove the bolt from a nut</td>
</tr>
<tr>
<td>2</td>
<td>Picking up a glass</td>
<td>Writing name</td>
</tr>
<tr>
<td>3</td>
<td>Picking up a saucepan (1 l of water)</td>
<td>Opening a jar</td>
</tr>
<tr>
<td>4</td>
<td>Turning a key</td>
<td>Threading a needle</td>
</tr>
<tr>
<td>5</td>
<td>Cutting putty with a knife</td>
<td>Cutting putty with a knife</td>
</tr>
<tr>
<td>6</td>
<td>Hammering a nail</td>
<td>Cutting putty with a knife</td>
</tr>
</tbody>
</table>

Patients and Methods
Between August 1997 and December 2000, patients older than 60 years of age who presented with an unstable, dorsally angulated, extra-articular fracture of the distal radial metaphysis (AO-A32 or Frykman types I and II33) were enrolled into this study. Approval was obtained from the Trust’s Ethics Committee and informed consent was obtained from all patients. The patients were then randomly allocated by tossing a coin to either the closed reduction or the percutaneous pinning groups. Patients with dementia or psychiatric illness, previous ipsi- or contralateral fractures of the wrist, intra-articular fractures, volar angulated fractures (Smith’s fracture), open fractures and dorsal comminution were excluded.

There were 57 patients in the study, 27 in the closed reduction group and 30 in the percutaneous pinning group. Three patients died before completion of the trial from unrelated conditions and were excluded. The analysis of the results was on an intention-to-treat basis. The mean age of the patients was 71 years (60 to 88). There was a similar age and gender distribution in each group with women outnumbering men by 8:1 (Table I). The mechanism of injury in all cases was a fall from standing height onto the outstretched hand. The degree of initial displacement of the fractures was similar in both groups. Six patients defaulted from the final follow-up at one year.

Protocol of treatment. All procedures were carried out under general anaesthesia within 24 hours of the injury and were performed or supervised by the senior author (SE). Closed reduction of the fracture was achieved under fluoroscopic guidance. In the closed reduction group, three-point fixation was obtained in a well-moulded, short-arm cast. In the percutaneous pinning group, the limb was prepared and draped before closed reduction. The fracture was reduced and then fixed using two crossed, smooth Kirschner (K-) wires, 1.6 mm in diameter, inserted through small stab incisions under fluoroscopic guidance. One wire was inserted through the styloid process of the radius and the other either through Lister’s tubercle or the dorso-ulnar border of the distal fragment, both wires engaging the opposite cortex. Damage to the superficial branch of the radial nerve and the extensor tendons was minimised by blunt dissection to bone. The pins were left protruding percutaneously and the wrist was then immobilised in a well-moulded short-arm cast as in the closed reduction group.

Assessment of outcome. Clinical and radiological reviews were performed at one, two and five weeks, after four months and at one year. The wires and plasters were removed after five weeks. The functional outcome was assessed by an orthopaedic specialist physiotherapist (TC) who was not blinded to the method of treatment since the pin-track scars could be easily observed. The range of movement of the wrist and forearm was measured using a goniometer and expressed as a percentage of the normal contralateral side.3 Grip strength was assessed by a Jamar dynamometer (Therapeutic Equipment Corporation, Clinton, New Jersey), and the mean of three readings was expressed as a percentage of the normal contralateral side, allowing 10% less for the non-dominant side.34,35 The ability to perform unilateral and bilateral activities of daily living (ADL) was also scored at each visit (Table II).36 The intensity of pain was recorded on a visual analogue scale from 0 to 10. An SF-36 questionnaire (IQOLA SF-36 Standard UK37) was completed after four months.38,39

Standardised anteroposterior and lateral radiographs of the wrist were taken with the forearm in neutral rotation.40 The dorsal angulation of the distal radius expressed as the number of degrees from the neutral position, the radial inclination and length, and ulnar variance were then measured.31,41,42 Radiographs of the uninjured wrist were obtained for comparison. The assessor of the radiological outcome was blinded to the functional outcome but not to the method of treatment.

Statistical analysis. This was performed using Minitab (version 12.12) (Minitab Inc, State College, Pennsylvania). The two groups were analysed using Student’s t-test for continuous variables. The Mann-Whitney U test was used for the analysis of continuous variables of non-parametric data. All tests of significance were two-tailed. Statistical significance was defined as p < 0.05.

Results
Clinical evaluation. The mean ranges of movement and grip strength at one year expressed as percentages of the normal side for the two groups are given in Table III. There was no statistically significant difference between the two groups except for ulnar deviation (p = 0.009). The mean scores for unilateral and bilateral ADL, pain and the SF-36 physical and mental component summary scores for the two groups are given in Table IV. Although the means for ADL, pain
and the physical component summary scores were greater in the percutaneous pinning group, the difference was not significant.

**Radiological evaluation.** The alignment at the time of reduction was anatomical in both groups. The means of the radial dorsal angulation, length and inclination and ulnar variance measured pre-operatively, post-operatively, after five weeks and at one year in both groups are given in Table V. There was a significant difference for radial dorsal angulation, length and inclination but not for ulnar variance at one year. There was no significant difference between the radiological parameters after five weeks and at one year in either group.

**Complications.** One patient required removal of the K-wires after two weeks because of infection in the pin tracks. There were no tendon or neurovascular injuries. One patient in the closed reduction group required remanipulation and fixation by percutaneous K-wires early after unacceptable redisplacement.

**Discussion**

Fractures of the distal radius are commonly encountered in orthopaedic practice with increasing numbers of low-energy fractures in the elderly. Several studies have suggested that there is a direct relationship between the anatomical result and the functional outcome, but most older patients with lower functional demands do relatively well in spite of obvious deformity.

While anatomical reduction can usually be achieved by closed manipulation, there is still no agreement as to the most appropriate way of maintaining reduction in unstable fractures.

Although several studies on the use of percutaneous K-wires for the stabilisation of distal radial fractures have been published, their use in an elderly population remains uncertain. These studies have included a heterogenous group of fractures and different regimes of treatment and although good results have been claimed, controlled trials are lacking. Stoffelen and Broos conducted a prospective, randomised trial comparing closed reduction with intrafocal pinning for extra-articular fractures. They found no difference in the outcome between the two groups. However, their series included young patients with both stable and unstable fractures, and excluded those older than 80 years of age.

Our prospective, randomised trial compared closed reduction and immobilisation in a cast alone, with additional percutaneous stabilisation by K-wires. All the patients in our study were older than 60 years and had a dorsally angulated, unstable, extra-articular fracture of the distal radial metaphysis (AO-A3 or Frykmann types I and II). The groups were matched for age, gender and duration of immobilisation. All fractures were immobilised in a well-moulded, short-arm cast with three-point fixation. Previous studies have shown no advantage of above-elbow casting.

We considered immobilisation of the fracture for five weeks
to be adequate and no significant loss of reduction occurred between five weeks and one year. We used a crossed K-wire construct since this configuration has been shown to provide the greatest stability. \cite{16,16} We found statistically significant differences in the radiological parameters between the two groups, but standardising lateral views of the wrist can be extremely difficult, and the magnitudes of the differences found were within errors of measurement. Even if such errors were excluded, our results showed that supplementary fixation by K-wire was only marginally superior to cast immobilisation alone in reducing displacement of the fracture after closed manipulation.

The improvement in functional outcomes for grip strength, range of movement and pain in patients treated by supplementary wires was not statistically significant, except for the range of movement in ulnar deviation. These correlated with the small differences in radiological parameters which were therefore of no clinical significance. This supports the opinion that K-wires do not gain sufficient purchase in osteopenic bone in elderly patients to maintain anatomical reduction of the fractures and to improve function. \cite{31}

Our findings indicate that supplementary K-wires do not provide better clinical outcomes in unstable, extra-articular, dorsally angulated, fractures of the distal radius.

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References