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ORIGINAL STUDY

Treatment of distal radial fractures with grafting and K-wiring

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We present a series of 10 distal radius fractures treated with either bone substitute or xenograft, and Kapandji's technique (intra-focal threaded Kirschner wires which lever on the graft before penetrating the opposite diaphyseal cortex). The Kirschner wires are buried.

Long term follow-up (one to five years, mean 2.8 years) shows very little secondary displacement (up to 3 mm loss of radial height on the antero-posterior views and none on the sagittal views), excellent tolerability and integration of substitute and good function.

The above operative technique has the advantage to allow immediate mobilisation of the wrist.

INTRODUCTION

Early loss of reduction has been frequently reported in fractures of the distal radius (*5*), even after satisfactory internal fixation (*2*). Secondary displacement has a composite aetiology. Foremost is the mechanism of injury, as compression with metaphyseal impaction produces a defect only visible post-reduction.

Although traditional methods of fixation allow adequate reduction of those fractures, they do not always prevent secondary collapse. We advocate a method with two specific features : firstly, the filling of the defect with a bony substitute, secondly the use of intra-focal Kirschner wires, which rest directly against the graft before breaching the opposite cortex. These features provide enough stability so that immediate mobilisation post-operatively is possible. We report here the results achieved using this method in ten patients.

PATIENTS AND METHODS

We included in this study 10 female patients aged from 58 to 87 (mean age 75.5 years) with unilateral isolated comminuted fracture of the distal radius and without significant intra-articular fractures. None of the patients had ever sustained an injury to the contralateral wrist. All patients lived at home, and remained independent in their daily activities. Four patients received bovine bone graft, the other six received tricalcium phosphate grafts.

Technique

With the patient supine, under regional or general anaesthesia, and the affected arm resting on an arm board, a 5-cm longitudinal incision is performed on the

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Fig. 1. — Intra-operative AP and lateral radiographs of the wrist

radial aspect of the wrist, centered dorsally over the fracture site. Careful dissection allows identification and sparing of the sensory branch of the radial nerve.

The first extensor compartment is identified and incised longitudinally. The tendons of abductor pollicis longus and extensor pollicis brevis are retracted either volarly or dorsally according to the configuration of the fracture.

The fracture site is then readily exposed and the fracture is reduced with traction along the thumb, with wrist flexion and ulnar deviation. Under image intensifier guidance, the presence of a bony defect is ascertained. If a defect is present, a graft is needed.

The bony substitute must not be too fragile or friable (*4*). We used tricalcium phosphate in six patients (Calciresorb, Beta Tricalcium Phosphate, Ceraver ; Paris, France) and bovine bone in four patients (Oxbone, Bioland ; Toulouse, France) shaped as a wedge of appropriate thickness to match the bone defect. To place the wedge correctly, it may be necessary to tenotomise the tendon of brachio radialis (with no detrimental clinical effects), and to flatten the edges of the fracture site with a flat instrument (e.g. a small chisel). The bone substitute is then impacted in the fracture gap with a punch. The first threaded Kirschner wire is then inserted in the radial aspect of the fracture site and proximally to the graft, on which it rests. We insert it first transversally, and then we tilt it 45° in a proximal and ulnar direction, to penetrate the opposite radial cortex on the ulnar aspect of the radius to control and maintain the graft in a distal position.

Under image intensifier control, a second Kirschner wire is then inserted dorsally through a limited longitudinal incision (2 cm long) just over Lister's tubercle and lateral to the fourth extensor compartment, avoiding the extensor pollicis longus. This Kirschner wire is also inserted proximal to the graft, and will be directed proximally to engage the opposite anterior radius cortex (fig 1, 2).

A third Kirschner wire may be used in patients with extensive epiphyseal comminution (fig 3).

The Kirschner wires are cut and remain subcutaneous. Their extremities are covered by a blunt protective spherical cap (Broches à butée, Fixano, Personnas,

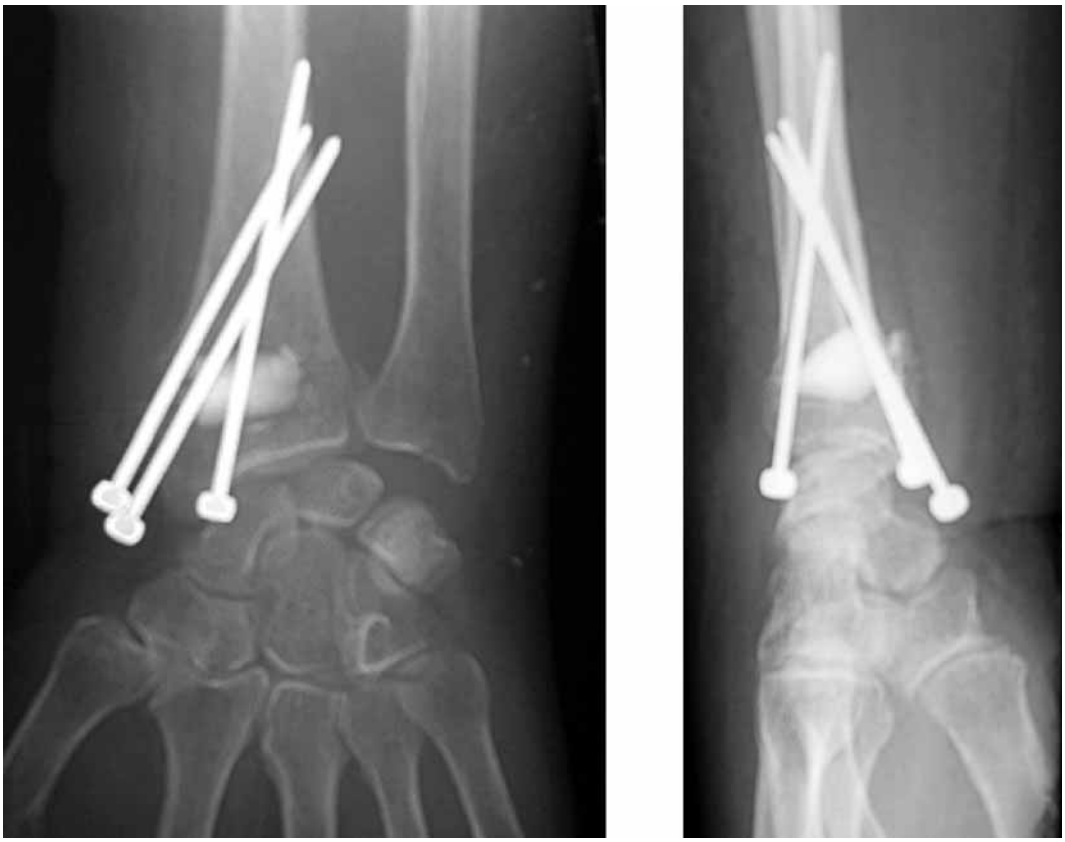

Fig. 2. — AP and lateral radiographs of the wrist on day 1 after internal fixation

France) before being buried. The skin is sutured with absorbable interrupted stitches.

Post-operative management : The wrist is placed in a removable splint, which will be removed several times a day to allow mobilisation from the first post-operative day. After 10 days, the wrist is left free, but any strenuous activity is forbidden until removal of the K-wires, usually performed under local anaesthesia in the outpatient department six weeks after the index procedure, after plain antero-posterior and lateral radiographs confirmed bony union. No formal physiotherapy referral was organised. Patients were seen again 3 months later for final check up, when plain antero-posterior and lateral radiographs were taken (fig 3).

Patients were followed-up for the purpose of this study and both wrists underwent plain antero-posterior and lateral radiographs.

The criteria used for assessment were : Cosmesis (scars and deformities as perceived by the patient and the examiner), pain, symmetry of range of movement as compared with the opposite wrist, power of grip and patient perception of their overall wrist function in daily life ; antero-posterior and lateral radiographic appearance.

No patient suffered post-operative complications (infection, neurological deficit).

RESULTS

Follow-up ranged from 1 to 5.5 years (mean follow-up time 32 months). Final assessment was performed by an orthopaedic trainee not involved in the initial management of the patients (table I).

Cosmetic results : The scars were minimal to invisible in all patients. A prominent ulnar styloid was noticed by the examiner in four patients, but perceived as such by three of these four patients. The presence of a prominent ulnar styloid was not associated with pain.

Table I. — Overview of the clinical data

	Age	F/U	X-ray (AP)	ROM	Deformity	Pain	Function
1*	84	5 y			Yes		Full
2	78	1 y	-2 mm		Yes		Slight weakness
3*	80	4 y	-2 mm	-5° sup	Yes		Full
4*	72	5 ½ y	-3 mm	-5° pro -3° add			No heavy lifting
5	74	1 ½ y					No heavy lifting
6	87	2 y				Occ.	Full
7*	71	4 y					Full
8	76	3 y	-3 mm		Yes		Full
9	75	1 y					Full
10	58	1 y					Full

* Denotes the use of bovine bone.

Fig. 3. — AP and lateral radiographs of the wrist three months after internal fixation

Radiographic appearance : In four patients, a loss of radial height (on the ulnar side) of up to 3 mm was noted on the antero-posterior view. Palmar tilt remained adequate in all the lateral views. Of these patients, one had received bovine graft.

Pain : Only one patient complained of occasional pain for which she took no analgesia. She also presented thenar wasting and degenerative changes at the thumb metacarpo-carpal joint.

Range of Motion : It was symmetrical in 8 patients. One patient lacked 5° of supination,

which did not interfere with overall function. Another patient lacked 5° of pronation and 3° of wrist adduction : she reported difficulty in lifting heavy pans and a tendency to drop things.

Power : It was tested as grip strength (standard neurological grading from 0 to 5). This was grade 5 in eight patients, and grade 4 in two patients. Of those two patients, one complained of difficulty with heavy pans (see above), the other complained that her wrist was slightly weaker.

Function : seven patients did not report any difference between the fractured and uninjured wrist. The remaining three patients, of whom two had osteoarthritis of the basal joint of the thumb, complained of difficulty when lifting heavy objects and a tendency to drop things. Of those three, one had lost 3 mm of radial height, one 2 mm, and the third none.

DISCUSSION

The filling of bony defects in fracture of the distal radius had already been proposed by Charnley in 1970 (*6*). Schmalholz used acrylic cement for distal radial fractures (*6*). To that effect, bovine bone has been used for a number of years and integrated well, however the risk of encephalopathy now prohibits it. More recently, different synthetic bone substitutes have become available (hydroxyapatite, tricalcium phosphate) (*3*).

In our series the use of either bovine bone or tricalcium phosphate did not influence the end result. It is important to use a substitute that is not friable and will resist compression (*4*). Tricalcium phosphate is well suited in that respect (*3*).

The technique of osteosynthesis with Kirschner wires described by Kapandji (*1*) aims to support the epiphysis with 2 or 3 intra-focal wires. It allows early mobilisation and hence aims to decrease the incidence of reflex dystrophy, however it does not always prevent subsequent displacements.

The wires carry frequent complications, i.e. cutaneous infections and migrations. The use of threaded and buried wires avoids these complications.

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