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## CASE REPORT

# The treatment of angulated radial neck fractures with calcium phosphate bone cement A new technique

M.J. Mitchell, J.F. Keating<sup>\*</sup>, J.T. Reid*Edinburgh Orthopaedic Trauma Unit, Edinburgh Royal Infirmary, Old Dalkeith Road, Royal Infirmary, Little France, Edinburgh, Scotland EH16 4SU, UK*

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## Introduction

Radial neck fractures account for 1% of elbow injuries in children.<sup>7</sup> In adults they are less common. Non-operative treatment is considered acceptable for radial neck fractures with less than 30° of angulation.<sup>16</sup> If the angulation is in excess of this, then a poor outcome is likely to occur unless surgical correction is performed. Reported complications of radial neck fractures include, pain, valgus deformity, decreased range of motion, and non-union.<sup>18</sup> The optimal surgical procedure for this fracture remains controversial. Manipulative reduction may be attempted.<sup>19</sup> If this fails then percutaneous reduction using a Kirschner wire has been described.<sup>10,17</sup> If an acceptable position cannot be achieved then open reduction must be considered. Internal fixation in this area is difficult for anatomic reasons. The proximal fragment is almost entirely articular, and the proximity of the posterior interosseous nerve renders distal access hazardous.<sup>15</sup> Implants in this area may well restrict pronation and supination. We describe a novel treatment of

these injuries using calcium phosphate cement without the need for additional fixation.

## Case reports

### Case 1

A 17-year-old right hand dominant female fell heavily onto her outstretched right arm. She developed a painful elbow and radiographs taken in the emergency department demonstrated a fracture of the right radial neck with 50° of angulation (Fig. 1). There was no distal neurovascular dysfunction or clinical signs of elbow instability.

Five days after injury a closed reduction was attempted, but failed. An attempt was then made to reduce the radial head using a percutaneous Kirschner wire under fluoroscopic guidance. It was possible to improve the position, but the reduction could not be maintained once the wire was withdrawn.

The radio-humeral joint was explored via the lateral approach. A radial neck fracture with subchondral comminution was noted. There was an intact periosteal sleeve on the posterior, medial and anterior aspect of the fracture. A decision was made to reduce and fix the fracture using

<sup>\*</sup> Corresponding author. Tel.: +44 131 242 3436; fax: +44 131 242 3467.

E-mail address: [john.keating@ed.ac.uk](mailto:john.keating@ed.ac.uk) (J.F. Keating).



**Figure 1** Preoperative AP and lateral radiographs demonstrating displaced radial neck fracture with 50° of angulation.

calcium phosphate cement (Norian SRS, Stratec, UK). A temporary subchondral K wire was introduced and the radial head fragment was held in the reduced position by an assistant. The defect between the head and shaft was then cleaned of debris and irrigated. Once the fracture void was clean the defect was filled with 3 ml of cement. Following the cement curing, the K-wire was removed.

The postoperative radiographs indicated a satisfactory reduction had been achieved. The patient was maintained in a plaster backslab for comfort for a period of 10 days, and then referred for physiotherapy. Three months after the injury the reduction had been maintained (**Fig. 2**). The patient was completely asymptomatic and had regained a full range of elbow motion, including pronation and supination.



**Figure 2** Final check AP and lateral radiographs taken 3 months postoperatively showing no loss of reduction.

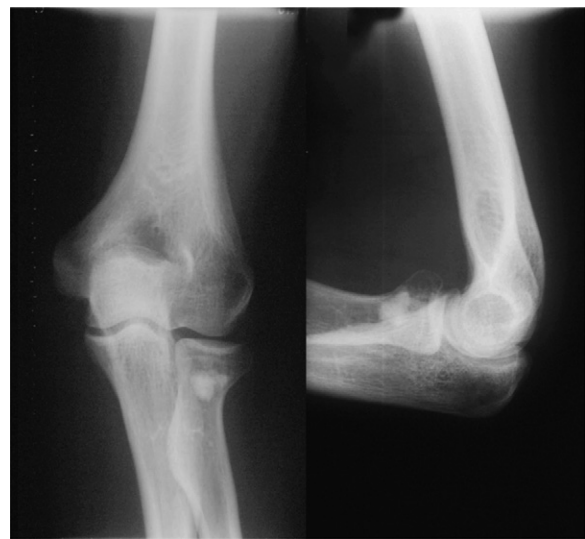


**Figure 3** Preoperative AP and lateral radiographs demonstrating displaced radial neck fracture with 60° of angulation.

## Case 2

A 25-year-old male right hand dominant call centre worker fell onto to his outstretched left hand whilst under the influence of alcohol. He presented to the emergency department the following day with pain and swelling around his elbow. On examination he kept his arm in 90° of flexion, and had was unable to pronate or supinate. Plain film radiographs revealed a fracture of the left radial neck with 60° of angulation (**Fig. 3**).

A decision was made to internally fix the fracture and this was undertaken 3 days post injury. A direct lateral Kocher approach was made inferior to the lateral ligament. The annular ligament was lifted off the ulna, and the radial head was exposed, revealing



**Figure 4** Final check AP and lateral radiographs taken 7 months postoperatively showing no loss of reduction.

a medial metaphyseal defect. The radial head was reduced and held with manual pressure and the defect was filled with calcium phosphate cement. A satisfactory reduction was achieved.

The patient was discharged home in a plaster backslab, which was removed on the 10th post-operative day, after which he was referred to physiotherapy. At his final clinic appointment 7 months post operatively, he had a full, pain free range of elbow flexion-extension, and forearm pronation-supination. His final check radiographs demonstrated no loss of reduction (Fig. 4), and he was back participating in sports.

### Case 3

A 52-year-old right female hand dominant sign language teacher, sustained a fall directly onto her elbow whilst out walking her dog. She presented to the emergency department the same day, complaining of lateral elbow pain and stiffness. On examination she had pain and tenderness over the proximal radius, and plain radiographs revealed a displaced radial neck fracture with 60° of angulation (Fig. 5).

The decision was made to undergo internal fixation, which took place 2 days post injury. A lateral approach was used, the radial head exposed and reduced, and held in place with a single K-wire. The resultant defect in the radial neck was then filled with 2.5 ml of calcium phosphate cement, and the K-wire removed following curing of the cement.

The patient was discharged on the second post-operative day, and was kept in a plaster backslab for a further 10 days, at which point she was referred to



**Figure 5** Preoperative AP and lateral radiographs demonstrating displaced radial neck fracture with 60° of angulation.



**Figure 6** Final check AP and lateral radiographs taken 4 months postoperatively showing no loss of reduction.

physiotherapy. The patient made a steady recovery and 4 months later had a full and pain free range of elbow flexion-extension and forearm pronation-supination, and was back to her work with no problems. Radiographs at the time of discharge time showed maintenance of the reduction (Fig. 6).

### Discussion

Calcium phosphate cements of various types have become popular in the management of metaphyseal fractures. Good clinical results have been reported in studies of distal radial fractures,<sup>1,4,12</sup> proximal humeral fractures,<sup>11</sup> intertrochanteric hip fractures,<sup>3,9</sup> tibial plateau fractures<sup>5,8</sup> and calcaneal fractures.<sup>13</sup> There are no previous reports of the material in the management of radial neck fractures. These fractures may be difficult to treat if they are displaced and a closed or percutaneous reduction cannot be achieved. The reported series of open reduction with or without internal fixation have been associated with high rates of complications.<sup>14</sup> The use of Kirschner wires has been associated with implant failure and damage to the articular surface. Even small plates may interfere with pronation-supination and the posterior interosseous nerve is vulnerable to injury during exposure and plate application.<sup>15</sup>

The technique we describe has a number of advantages in treatment of displaced radial neck fractures. Only a limited exposure is required to insert the cement, minimising the risk of iatrogenic nerve injury. The surgery is technically straightforward since the subchondral defect was contained by

a sleeve of periosteum on the anterior, medial and posterior aspects of the fracture which allowed the cement be injected into a contained space from the lateral aspect. A very stable reduction was achieved in each case, allowing for early mobilisation. All the material is confined to the subchondral defect and there is therefore no mechanical impingement to pronation and supination, which was rapidly regained postoperatively in all cases. Experimental work in a dog model<sup>2</sup> indicates the material to be osteoconductive, and is gradually turned over by adjacent bone, hence leaving no potential block to bony union. Although resorption is slower in humans than shown in animal studies,<sup>2,6</sup> replacement by bone and eventual remodelling does occur, leaving bone of normal strength and shape. Since no metal implants are used, there is no need for any subsequent surgery to remove implants. The final radiographs demonstrated no loss of reduction in any of the patients, despite early mobilisation being introduced from the 10th postoperative day.

The use of calcium phosphate cement has proved a safe implant with good results in other anatomic locations. This series demonstrates it may be very useful role in the treatment of angulated radial neck fractures. On the basis of our experience, it has proved to be both a simple and effective way of treating these fractures, with no adverse clinical outcomes noted. This is a potentially very useful addition to existing indications for use of this material. Further clinical experience is required to corroborate our observations.

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