The treatment of isolated ulnar fractures in adults: a systematic review
Mackay D, Wood L, Rangan A

Authors' objectives
To perform a systematic review of the treatment of isolated ulnar diaphyseal fractures.

Searching
The authors searched MEDLINE, BIDS, EMBASE, and the Cochrane Controlled Trials Register from 1976 onwards using the keywords 'ulnar fracture', 'radial fracture', 'forearm fracture' and 'night-stick fracture'. The references of retrieved papers were also checked. No language restrictions were reported.

Study selection
Study designs of evaluations included in the review
Study design was not stated a priori. The included studies were retrospective case series and prospective comparative trials.

Specific interventions included in the review
The treatments included: immobilisation in an above elbow plaster cast (AEPOP; 8 studies) or below elbow plaster cast (BEPOP; 9 studies) until union; functional bracing using a moulded lightweight plastic brace (6 studies); early mobilisation (5 studies); internal fixation with a dynamic compression plate (10 studies); internal fixation with a Mennen plate (1 study); internal fixation with intramedullary Rush pins or K wires (3 studies); locked intramedullary nail (2 studies); and unlocked intramedullary nail (1 study).

All studies excluded Monteggia fracture dislocations, and proximal ulnar, olecranon and coronoid process fractures.

Participants included in the review
Adult patients with ulnar shaft fractures. Studies of child participants, olecranon fractures, and combined radial and ulnar fractures were excluded.

Outcomes assessed in the review
The outcome measures were time to union, nonunion rate, functional outcome, residual deformity and complication rates. Five publications which did not define outcome measures sufficiently to allow analysis, or were seriously flawed, were excluded.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
Study design (prospective or retrospective), patient inclusion criteria, randomisation, patient numbers, method of assessment, loss to follow-up, and other biases were recorded. It is not stated what the authors did with these data. One author performed the minimal quality assessment outlined.

Data extraction
One author performed the data extraction using a standard proforma developed from the Cochrane Musculoskeletal Injuries Group. Data were extracted for study design, including whether retrospective or prospective, patient inclusion criteria, randomisation and patient numbers. The details of patient groups (age, gender, occupation), fracture classification (site, degree of displacement, comminution, number open), mechanism of injury, and treatment method were also recorded.
Methods of synthesis
How were the studies combined?
The authors state that where the treatment and outcome measures were sufficiently standardised, the results for different series were combined to give mean values. No further statistical analysis was deemed possible.

How were differences between studies investigated?
The authors do not report a method for assessing heterogeneity.

Results of the review
Thirty-three studies with 1,876 participants were included in the review. The majority were retrospective reviews of one treatment method. Thirteen trials were prospective, but only five of these compared two or more treatments.

For the nonsurgical treatments, the average time to union was 7.1 weeks for early mobilisation, 8.6 weeks for AEPOP, 9.1 weeks for BEPOP, and 9.7 weeks for functional bracing.

Nonunion rates ranged from 2 to 4%.

Excellent or good functional results were achieved in 88% of AEPOP, 90% of BEPOP, 95% of early mobilisation, and 96% of functional bracing patients. Complication rates ranged from 0 to 4%.

In the surgical group, time to union was 15.5 weeks for unlocked Kuntscher nail, and 10.4 weeks for locked Lefevre nails. Compression plates, Mennen plates and Rush pins had an average union time of 12.1 to 12.4 weeks.

Nonunion rates were: for the Lefevre nail and Mennen plate, 0%; compression plates, 2%; unlocked Kuntscher nail, 5%; and Rush pins, 13%. Functional outcome was excellent or good in 72% of patients following locked intramedullary nailing, and in 79% following unlocked intramedullary nailing; it was 83 to 86% following other forms of surgery. Complication rates ranged from 6 to 16%.

Authors’ conclusions
The authors state that despite the existence of many papers dealing with isolated ulnar fractures, no consensus on the best form of treatment exists. The authors conclude that:

1. Fractions with minimal displacement, which are judged to be stable, can be successfully treated in BEPOP, functional brace or by early mobilisation. An AEPOP is unnecessarily restrictive.

2. Widely displaced or unstable fractures should be treated by open reduction and internal fixation using a compression plate. Other forms of surgical treatment remain unproven.

3. Fractures displaced more than 25 to 50%, or angulated more than 10 to 15 degrees, should be considered potentially unstable.

CRD commentary
The authors have stated the research question and inclusion and exclusion criteria. The literature search was reasonably thorough and was not restricted to English language publications. There were no tests for publication bias. It is possible that additional studies may have been missed.

The quality of the included studies was not formally assessed, although the authors did record some information on some aspects of validity; this, however, was not presented. The authors have not reported how the articles were selected, or who performed the selection of studies. In addition, it was unclear who performed the data extraction.

The data extraction was reported in tables and discussed in the text of the review. Study details and individual outcomes were described in the text and tables. Table 7 presented combined data, which was inappropriate given the
design of the included studies and the lack of a heterogeneity assessment. Whilst the authors did not perform any tests for heterogeneity or further sensitivity analyses, they have discussed in the text the fact that the included studies varied widely in their approaches.

The authors' conclusions appear to follow from the results, but should be viewed with much caution because of limitations in the quality of the review process.

**Implications of the review for practice and research**
The authors did not state any implications for further research and practice.

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