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ORIGINAL ARTICLE

Compared outcomes after percutaneous pinning versus open reduction in paediatric supracondylar elbow fractures

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Child elbow fracture;
Crossed pinning;
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Surgical treatment

Summary
Background: Supracondylar fractures of the elbow are common in children. Their treatment is controversial when displacement has occurred, although percutaneous pinning is usually advocated.
Hypothesis: In paediatric extension-type supracondylar fractures of the elbow, percutaneous pinning and crossed K-wire fixation after open reduction via the medial approach produce similar functional outcomes and complication rates.
Materials and methods: We retrospectively reviewed the medical charts of 58 children aged 2 to 15 years who underwent surgery for extension-type supracondylar elbow fractures between 2004 and 2008. Closed reduction and percutaneous pinning was used in 33 patients with a mean age of 7 years and 11 months; open reduction with cross-wiring in 25 patients with a mean age of 7 years. Functional outcomes were assessed using Flynn's criteria. Baumann's angle was determined and postoperative complications and sequelae were recorded.
Results: Outcomes were satisfactory in 30 (90.9%) patients treated with percutaneous pinning and in 23 (92%) patients treated with open reduction and cross-wiring. Mean Baumann's angle at last follow-up was $73.9 \pm 5.74^\circ$ after percutaneous pinning and $74.76 \pm 4.07^\circ$ after open reduction and cross-wiring. Postoperative complications consisted of reoperation in six (10.3%) patients and iatrogenic nerve injury in two (3.4%) patients. Cubitus varus occurred in two (6.06%) patients after closed treatment and in one (4%) patient after open treatment. In each group, three (5.1%) patients had greater than 15° of motion range limitation.

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Discussion: In children with extension-type supracondylar elbow fractures, outcomes are similar with percutaneous pinning and with open reduction via the medial approach followed by cross-wiring.
Level of evidence: Level IV, retrospective study.

Introduction

Supracondylar fractures of the elbow account for 16.6% of all fractures in paediatric patients [1]. The broad range of non-operative and operative methods developed with the goal of restoring normal elbow anatomy include long-arm plaster cast immobilisation, axial traction applied using tape or a transolecranon pin, Blount's technique, elastic and stable intramedullary nailing, external fixation, percutaneous pinning, and pinning after open reduction [2—5]. Percutaneous pinning is the most widely advocated technique [2—4,6,7]. Open surgery is indicated in patients with irreducible fractures, unstable fractures, vascular complications, or compound fractures [1]. In our department, Blount's technique has been preferred since the study by Clavert et al. [8]. When Blount's technique fails, percutaneous pinning as described by Judet and Judet is performed as the first-line treatment when reduction is satisfactory [9] and open reduction via the medial approach followed by crossed K-wire fixation otherwise. This treatment algorithm is based on the hypothesis that percutaneous pinning and open medial reduction with cross-wiring produce similar functional outcomes and complication rates. We give preference to the less aggressive of these two techniques whenever possible. The objective of this retrospective study of paediatric patients with extension-type supracondylar elbow fractures was to confirm our hypothesis by comparing patients managed with percutaneous pinning and those managed with open reduction and cross-wiring.

Materials and method

Study population

We retrospectively reviewed the medical charts of 82 patients younger than 15 years at the time of treatment for extension-type supracondylar elbow fractures. These patients were managed between 2004 and 2008 at the paediatric orthopaedics department of the Hautepierre Hospital, Strasbourg, France. We excluded patients with flexion-type fractures, associated bony injuries in the same limb, and incomplete data. Patients were included if they received regular postoperative follow-up for at least 3 months. Of the 82 patients, 58 met these criteria and were included in the study. There were 31 (53.4%) boys and 27 (46.6%) girls with a mean age of 7 years and 6 months and an age range of 2 to 15 years. The fractures were classified according to Lagrange and Rigault [10] (Table 1).

Operative treatment

Surgery was performed under general anaesthesia by a senior surgeon in all 58 patients. Time to treatment was defined as the time from emergency department admission to arrival in the operating room. When Blount's technique failed and closed reduction of the fracture was satisfactory, percutaneous pinning was performed. When closed reduction was not satisfactory, open reduction was performed via the medial approach then stabilised using crossed K-wire fixation. Patients with recurrent displacement after percutaneous pinning were also managed using cross-wiring.

For percutaneous pinning, the surgeon gradually applied traction to the limb with the elbow extended while the assistant applied counter-traction at the axilla. Fluoroscopy was used to determine whether translation of the distal humerus occurred. While gradually flexing the elbow to about 120°, the surgeon applied direct pressure to the olecranon with the thumb to correct any residual posterior tilting. With the elbow flexed, anteroposterior and lateral radiographs were obtained to evaluate the quality of the reduction. An Esmarch's bandage was placed to maintain the position. After sterile preparation of the elbow, two identical wires 1.6 to 2 mm in diameter were inserted from lateral to medial, using a slow-rotation power drill (Fig. 1).

For cross-wiring (Fig. 2), a medial incision centred on the medial epicondyle was performed and the ulnar nerve was isolated and placed in a noose. The fracture site was then approached via the intermuscular interstice. Reduction was achieved and a wire 1.6 to 2 mm in diameter was then inserted from medial to lateral using a slow-rotation power drill. A lateral wire of the same diameter was inserted percutaneously under fluoroscopic guidance starting at the lateral epicondyle. The wound was closed in two planes with a continuous intradermal suture.

In all patients, the wires were bent back and buried under the skin. A long arm plaster cast with the elbow flexed at 90° was used in all patients for 45 days, after which the wires were removed under general anaesthesia.

Comparison of the two operative techniques

To compare the two operative techniques, we retrospectively allocated the patients into two groups based on the surgical technique used. Although treatment allocation was not randomised, provided the two groups were homogeneous, this method allowed comparisons of treatment outcomes. The percutaneous pinning (PP) group included 33 patients (20 boys and 13 girls) with a mean age of 7 years and 11 months and the open reduction/crossed pinning (OR/CP) group included 25 patients (11 boys and 14 girls) with a mean age of 7 years.

Table 1 reports the main epidemiological, diagnostic, and therapeutic features in the study patients. Associated injuries were present in 24 (41.3%) patients and consisted of vascular abnormalities in nine (14.5%), nerve injuries in 10 (16.1%), and breaks in the skin in five (8%). Of the nine vascular abnormalities, seven were arterial spasms