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Nonoperative treatment of displaced supracondylar fractures in children

Rigault type 2 fractures

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Background Current opinion in the medical literature concerning displaced supracondylar fractures of the distal humerus recommends pinning because with flexion braces there is a risk of both secondary displacement and Volkmann syndrome.

Patients and methods We analyzed 84 children with displaced supracondylar fractures. According to Rigault's classification, 30 children had grade 2 fractures, 21 had grade 3, 28 had grade 4 and 5 had multiple fragments, which were thus outside this classification. Fractures that could be reduced to a stable position under general anesthesia were treated with a posterior long arm splint with an average elbow flexion of 113° (90–140). This technique was applied in 28 of the grade 2 fractures and in 4 of the grade 3 fractures, but in none of the grade 4 fractures.

Results Of the 4 cases of Rigault grade 3 fractures treated nonoperatively, 3 had to be re-reduced and 1 needed an operation later on for varus correction. Of the 28 Rigault grade 2 fractures, 27 showed excellent results, and 1 had a good result. We advise nonoperative treatment in type 2 supracondylar fractures if stable reduction is achieved.

Supracondylar fractures of the distal humerus account for 60% of all fractures of the elbow and for 3% of all fractures in children (Arnold 1977, Otsuka and Kasser 1997, Cheng et al. 1999), with a peak incidence between 4 and 7 years of age.

Typically, the fracture occurs due to a fall onto an outstretched hand with hyperextension of the elbow joint (Kasser 2001). Previously, these fractures were treated by closed reduction with casting or traction. These approaches have generally been abandoned, however, because of difficulties in maintaining adequate alignment and circulation to the limb simultaneously, particularly in the case of displaced fractures (Lee et al. 2002). The current preferred method of treatment of displaced fractures is closed reduction with percutaneous pin stabilization, which allows casting in less elbow flexion. We carried out a retrospective investigation as to whether there is still a place for nonoperative treatment in displaced supracondylar fractures.

Patients and methods

We conducted a retrospective chart review of children under the age of 16 years with displaced supracondylar fractures who were treated at our institution from 1993 through 2000 after obtaining institutional review board approval. 84 children for whom there were full charts and radiographs were included. Fractures were classified according to the grading of Rigault (Lagrange and Rigault 1962), but with the modification of the type 2 grading by Pirone et al. (1988) (Figure; Table 1).

An attempt at closed reduction under general anesthesia was first made. If stable reduction was



Rigault 2 (Pirone type 2 A)

Rigault 2 (Pirone type 2 B)

Rigault 3

Rigault 4

Table 1. Rigault classification

| | |
|---------------------|---|
| Grade 1 | The fracture takes only the anterior cortex of the humerus, with no displacement. (These fractures were not included in our study). |
| Grade 2 | The fracture takes the anterior and posterior cortex of the humerus, with no displacement, but there is a posterior tilt. |
| Grade 3 | There is a displaced fracture, but there is still contact between both ends. |
| Grade 4 | There is no contact between both fragments of the fracture. |
| Pirone modification | |
| Type 2A | Distal fragment with a posterior tilt. |
| Type 2B | Only posterior displacement. |

Table 2. Flynn classification

| | Excellent | Good | Fair | Poor |
|---|-----------|--------|---------|-------|
| Carrying angle ^a | < 5° | 6°–10° | 11°–15° | > 15° |
| Reduced ROM ^b | < 5° | 6°–10° | 11°–15° | > 15° |
| ^a Difference in carrying angle between both elbows. | | | | |
| ^b Reduced range of motion from one elbow to the other. | | | | |

achieved with the elbow brace in flexion with an average angle of 113° (90–140) and a normal hand perfusion with good oxymetry (100%), the arm was fixed to the chest with a band to restrict rotatory motion. If the fracture was not stable, pin fixation was performed. Medial condylar pinning was carried out with a small incision. After 3–4 weeks of cast immobilization, the brace was removed at the outpatient clinic and the bony union was examined radiologically. If pins were used for fixation, they were removed from the skin at that time without anesthesia. The children were encouraged to perform active elbow exercises from the day after the pin or brace was removed. The quality of reduction was assessed radiographically by the congruence

(percentage of contact between fragments) in the frontal and lateral views (Zatti et al. 2001). Healing was determined from radiographs and clinical examination. The final results were rated according to the criteria of Flynn et al. (1974) (Table 2) which evaluates carrying angle malalignment and loss of range of motion.

Results

84 displaced supracondylar fractures of the distal humerus (in 48 boys and 36 girls) were treated between January 1993 and December 2000. The mean age at fracture was 6.6 (1.2–14.3) years. The mean duration of follow-up was 4.5 (2.5–10) years. According to the Rigault fracture classification (Table 1), 30 patients had grade 2, 21 had grade 3, 28 had grade 4, and 5 involved multifragments—which were thus outside the classification. 2 were open fractures and these were recorded as Gustilo type 1 and type 2. 79 supracondylar fractures were isolated injuries and 5 were associated with other fractures.

28 of the 30 Rigault grade 2 fractures were treated with closed reduction and flexion brace. The 2 other fractures necessitated pinning for stability. Of the 28 cases, 27 had excellent results, and 1 had a good result (10° varus) according to the Flynn classification. 17 of the 21 Rigault grade 3 fractures were managed surgically (14 cases with percutaneous pinning after closed reduction and 3 cases with pinning after open reduction). Of the 4 cases with Rigault grade 3 fractures treated nonoperatively, 3 had to be re-reduced and 1 eventually required an osteotomy for varus correction. All of the Rigault grade 4 fractures and the multifragmented fractures required surgical management.

6 nerve injuries were diagnosed before treatment: 3 radial nerve, 2 ulnar nerve, and 1 case with radial and ulnar nerve lesions. These nerve injuries healed within 4 months. 1 of 52 patients treated with pinning had an iatrogenic ulnar injury, which was still without full recovery 2 years later.

4 cases of the 28 grade 4 fractures had a pulseless hand before reduction: 1 recovered pulse 24 hours later and the others regained a pulse a few hours after reduction. No Volkmann disease has developed among our treated children and no exploration of arteries were necessary. In 9 of the 52 children who required a pin fixation, the exposed pin caused a superficial skin infection. If one considers the final results for all 84 children, the Flynn classification was excellent in 76, good in 5, fair in 1, and poor in 2. In all cases, we found that when the initial reduction came to at least four fifths of congruence in the front view and two thirds in the lateral view, the results obtained were excellent.

Discussion

Today, most authors recommend Kirschner wire fixation (Mazda et al. 2001, Lee et al. 2002) to stabilize a supracondylar fracture because stable fixation allows the elbow to be extended sufficiently to reduce compression on the brachial artery (Pirone et al. 1988). Some authors favor nonoperative treatment (Clavert et al. 1984, 2002). Hadlow (1996) reported a satisfactory outcome in 37 of 48 patients with type 2 fractures and in 46 of 75 type 3 fractures treated by closed reduction and casting.

With nonoperative treatment, we found an unsatisfactory outcome in the 4 cases with type 3 fractures and a good outcome in all 28 patients with type 2 fractures. We consider it an advantage to avoid surgical management whenever possible because of the risk of iatrogenic complications; nerve injuries are not uncommon (Brown and Zinar 1995, Rasool 1998, Rose and Phillips 2002). Infections have not been reported frequently after pinning. We did, however, find superficial infections in 9 of 52 pinned fractures.

No competing interests declared.

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