Children distal humerus supracondylar fractures: The Blount Method experience

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Supracondylar fractures; Children; Blount method; Elevation

Summary
Introduction: Extension-type supracondylar fractures of the humerus in children are frequent lesions whose orthopaedic treatment remains under debate in Rigault and Lagrange type III fractures and highly controversial in type IV fractures. The objective of this study was to extend the Blount method to fractures with substantial displacement even in patients presenting significant swelling and to evaluate the results.

Patients and methods: We conducted a prospective continuous study from December 2005 to August 2007 on 67 children: 49 boys and 18 girls with a mean age of 6 years (range, 3–14 years). The mean time lapsed from consultation to treatment was 30 h. The mean hospital stay was 72 h. In 50 children, the limb was elevated preoperatively for a mean 48 h. The fracture was reduced under fluoroscopy-guided general anesthesia with mask and immobilized with 5-cm cloth banding padded with foam. The follow-up was clinical and radiological. The mean follow-up was 16 months (range, 6–26 months). Assessment followed the 1969 SOFCOT guidelines.

Results: At union, mean flexion was 124°, the mean extension lag was 26°. At last follow-up, the mean flexion was 146°, the extension lag was 0.5°, and pronation and supination were free. Immediately after surgery, the mean Baumann and anteflexion angles were 75° and 43°, respectively; at union they were 76° and 44° and at follow-up 79° and 42°. We found no vascular or nerve lesions. According to the SOFCOT criteria, at follow-up we obtained 80.6% very good results and 19.4% good results.

Level of evidence: Level IV. Therapeutic study.

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Introduction

Extension-type supracondylar fractures (SCF) of the humerus, the most frequent elbow injury in children, account for 55%–75% of elbow fractures [1]. In nondisplaced or slightly displaced fractures, the therapeutic indications are clearly codified, whereas displaced fractures remain controversial. Certain authors prefer surgical treatment with pin fixation, others defend orthopaedic treatment, apparently relegated to secondary importance.

Treating these fractures using the collar and cuff technique has a long history in the English-language literature and was recommended by a few authors such as Astley Cooper (1826), Robert Jones (1921), Watson Jones (1952/55), and Charnley 1961 [2].

Blount described a method of orthopaedic reduction with immobilization in flexion for these extension-type fractures reserved for patients who were seen early, before the appearance of substantial swelling [3]. Despite fewer vascular risks and better fixation of the fracture, percutaneous pin fixation carries its own risk: iatrogenic nerve lesions and infections, stiffness, and secondary displacements that can result in cubitus varus [4–6]. The need for a second intervention to remove the material and particularly the cost are arguments in favor of orthopaedic treatment. These reasons have encouraged us to review the therapeutic indications and to adopt those that respond best to our socioeconomic context. We have therefore returned to the Blount method, extending its indications to type IV extension SCFs in the Rigault and Lagrange classification (Fig. 1).

The objective of this study was to evaluate the results of this method in SCFs with substantial displacement.

Patients and methods

Patients

This was a prospective continuous study conducted from December 2005 to August 2007 at the Aristide Le Dantec Hospital in Dakar, Senegal.

All the patients recruited in the emergency unit, aged 3–15 years, presenting an extension-type SCF treated exclusively with the Blount method were included in the study. We excluded patients whose fracture was more than three weeks old and those who were lost to follow-up. In a population of 158 children with elbow injury, 79 patients had an extension SCF. Twelve patients were lost to follow-up. The only bone lesion associated was an ipsilateral fracture of the distal quarter of the two forearm bones, resulting in a floating elbow. This occurred in a 6-year-old patient who had fallen and landed on her hand, with the wrist and elbow in extension.

The study retained 67 children, 49 boys and 18 girls, with a mean age of 6.2 years (range, 3–14 years). The mean hospital stay was 72.4 h (range, 24–240 h). The patients were cared for and assessed with a mean follow-up time of 478 days (range, 182–794 days).

Method

In cases of substantial tumefaction (Fig. 2A, B), the limb was elevated in a 5-cm tubular bandage attached to a stand (Fig. 3) and ice was applied around the elbow. A nonsteroidal anti-inflammatory drug (NSAID) in suppository form was administered twice a day. The duration of this procedure depended on how quickly the swelling subsided, but not on the resorption of the edema or the hematoma: the mean duration was 2 days (range, 1–3 days).

Patient management was standardized. The examination sheet developed for the study was filled out in the emergency unit. It included data on the patients’ civil status, their medical history, the initial clinical examination, and the results of the initial radiographic examination.

Reduction and immobilization technique

In most cases, the patient was treated by the senior surgeon who initiated the technique. In the other cases, a resident who had been taught by the senior surgeon performed the surgery. The fractures were reduced under fluoroscopy-guided general anesthesia with mask. The patients were positioned in the decubitus dorsal position, with the injured elbow resting on the drum of the image intensifier.

A cuff and collar were fabricated in the operating room using 2-cm-thick foam. The length depended on the circumference of the patient’s neck and wrist. This foam was inserted into the 5-cm tubular bandage, which was 1.5 m in length. The collar was positioned around the neck, leaving two finger holes between the knot and the skin for patient comfort (Fig. 4). The associated ipsilateral fracture of the distal quarter of the two forearm bones was treated using a forearm cast after reduction using external maneuvers, performed in accordance with the Blount technique (Fig. 5). Good reduction was demonstrated by alignment of the internal and external columns of the distal humerus (Fig. 6).

The elbow was immobilized in flexion between 100° and 120°, depending on the tumefaction and the muscle mass (Fig. 5). The maneuvers lasted a mean 7 min (range, 5–10 min). When the patient awoke, an AP and lateral X-ray were taken immediately. The Baumann angle and the ante-
Figure 2  Elbow with tumefaction (A, AP; B, posteroexternal view).

Figure 3  Elevation of the injured limb.

Figure 4  Material necessary to make the collar and bracelet.

Flexion angle were measured immediately after surgery, at union, and at the follow-up.

The capillary pulse was verified. Pain and tolerance for the immobilization set-up were assessed. It was important to reassure the parents, inform them on the immobilization and the factors to avoid, as well as the precautions to take during the first 2 weeks.

Assessment criteria

The patients were assessed according to the 1962 SOFCOT criteria [7] based on elbow mobility after union and axis malalignment, classified as follows:

- very good: normal elbow;
- good: normal function but slightly reduced mobility and axis malalignment less than 10°;
- fair: limited mobility greater than 20° or axis malalignment between 10° and 20°;
- poor: stiffness greater than 50° and/or axis malalignment greater than 20° or residual paralysis.

We used Office 2007 software. The statistical tests were calculated using SPSS 16.0.

Results

The mean time lapsed to consultation was 30 h (range, 1–240 h). The mean time to intervention was 46 h (range, 1 h to 14 days). The mean hospital stay was 72 h (range, 24–240 h).

Fifty elbows (74.6%) were elevated because of swelling. There was no correlation between the delayed consultation and elevating the upper limb (p-value 0.752 > 0.05).

Three patients (4.5%) underwent revision surgery: two for absence of reduction or secondary displacement, one because of early removal by the parents. One patient presented ossificans myositis of the anterior forearm with no functional incidence. The radiographic results are listed in Table 1. There was no significant difference for the anteflex-
ion angle ($p$-value 0.214696 $> 0.05$), contrary to the Baumann angle ($p$-value 0.000515 $< 0.05$). Three patients (4.5%) presented cubitus varus with an 85° Baumann angle.

Postoperatively, the mean flexion range of motion was 124° (range, 85°–150°). The mean extension lag was 26° (range, 0°–80°). Pronation and supination were complete for all patients except for four, who had values equal to 70°/80°, 80°/70°, 70°/80°, and 60°/80°, respectively. At union, the mean mobility was 120° in flexion and 0° in extension.

**Table 1** Postoperative radiographic results at union and at follow-up.

<table>
<thead>
<tr>
<th></th>
<th>Baumann angle</th>
<th>Epiphyseal anteflexion</th>
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<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>Mean</td>
</tr>
<tr>
<td>Postoperative</td>
<td>67</td>
<td>75.45</td>
</tr>
<tr>
<td>Union</td>
<td>67</td>
<td>75.88</td>
</tr>
<tr>
<td>Follow-up</td>
<td>67</td>
<td>78.55</td>
</tr>
<tr>
<td>$p$-value (ANOVA test)</td>
<td>0.000515 $&lt; 0.05$</td>
<td>Significant difference</td>
</tr>
</tbody>
</table>

At follow-up, the mean flexion range of motion was 146° (range, 110°–150°). The mean extension lag was 0.5° (range, 0°–15°). Pronation and supination were normal in all patients.

We obtained 54 very good results (80.6%) and 13 good results (19.4%). The parents were all very satisfied except two who were moderately satisfied.

Discussion

Extension-type SCFs in children are very frequent. Since the middle of the 20th century, their treatment has considerably evolved with the widespread use of pin fixation. With the great variety of techniques, the therapeutic choice has become difficult, particularly for these lesions, opposing surgical treatment, dominated by open or closed pin fixation, and orthopaedic treatment with several reduction and immobilization modalities.

This raises a double problem: diagnostic in nondisplaced fractures and most particularly therapeutic in the highly displaced fractures with formation of significant swelling of the elbow that can be a source of vascular compression.

The Blount method [3], described in 1954, is founded on the integrity of the posterior periosteum and the triceps, which provides good stability in flexion, as underscored by Clavert et al. [8,9] and Damsin and Langlais [10]. However, the present study reveals that tearing of the periosteum in type IV SCFs is rather exceptional in that all the cases studied herein were stable after reduction. It occupies an important place in the orthopaedic armamentarium. Although it continues to be applied by some authors for fracture types I, II, and III, its use for type IV fractures has remained tentative and controversial because of the fear of complications, notably ischemic complications, particularly Volkmann contracture [6,11–13]. Blount [3] did not recommend his procedure for cases of neurovascular deficit or substantial displacement associated with severe swelling. For Damsin and Langlais [10], the contraindications are flexion-type fractures, unstable fractures, and vascular impairment. Nerve complications and edema are relative contraindications.

In Senegal, bonesetters are frequently consulted, which is often the first reflex in case of injury, which lengthens the time to consultation. Moreover, manipulations by traditional practitioners worsen the tumefaction and soft tissue lesions, making emergency treatment difficult if not impossible.

In the present study, as for Devnani [14], the time until the injury could be managed did not have an impact on the anatomic result. Comparing a group of patients seen in the first 12 h after injury and another group seen beyond this time delay, Gupta et al. [15] found no significant differences in the percentage of open reduction and the perioperative complications. However, Devnani [14], studying extension-type SCFs in 24 Garland type III and four type II fractures received after extremely long delays (2–21 days), found a high percentage of complications, with 25% cubitus varus.

Longer hospital stays are noted with olecranon traction and adhesive traction (mean, 2–3 weeks), but their results are close to the results found with other methods [2,11,16,17]. Our patients were hospitalized a mean 72 h. Elevating the arm was not necessary in 17 patients. The patients were seen a mean 43 h after their injury (range, 1–240 h). No significant correlation was noted between elevating the limb and the time to consultation (p = 0.813 > 0.05). Swelling resulted from soft tissue lesions and particularly from hematoma. Elevating the limb was particularly useful for reducing swelling. Associated with NSAIDs, absorption of the edema was rapid and elbow flexion was authorized with a lower risk of iatrogenic ischemia.

Thus, in contrast to Clavert et al. [8], we believe that edema and hematoma are not contraindications to the Blount method.

We found no studies using this method in preoperative management of extension-type SCFs in children. Badhe and Howard [16] believe that elevating the limb is effective for resorbing the edema. They use an olecranon screw to provide vertical traction, which also serves for the final treatment. With their procedure, the hospital stay increases considerably. Assessment of the results is based on radiographic angle measurements, which reflect the quality of the reduction. The Baumann angle is the most frequently used landmark, allowing one to detect a major complication with these fractures: cubitus varus.

According to Skagg et al. [18], the Baumann angle varies from 6° for each 10° of humeral rotation. Comparing two lateral pin fixation methods in displaced fractures, they considered a 12° variation in this angle to be a significant difference. They found an immediate postoperative angle of 82.1° ± 5.2° (p = 0.876) and 82.2° ± 5° at union (p = 0.893). The greatest difference between the measurements was 7°, which was not significant. Comparing lateral crossed wire fixation in 131 patients presenting a displaced extension-type SCF, Sibinski et al. [19] noted only five cases of significant change in the Baumann angle with cubitus varus. The results of surgical treatment of extension-type SCFs show variations in the Baumann angle as they evolve [20]. These are in accordance with our results.

In our study, the mean angle values were 75.45° ± 5.346 immediately after surgery, 75.88 ± 5.811 at union, and 78.55 ± 3.111 at follow-up, with a significant difference (p = 0.000515 < 0.05). There was a trend of progression toward cubitus varus without going beyond the normal range.

The epiphyseal anteflexion angle is less important and infrequently used. Some authors [18,21,22] prefer the anterior humeral line. According to Blount [3], residual displacement is easily corrected near the joint and particularly in the motion plane. This principle has encouraged several authors, including Piggot et al. [2], not to seek perfect reduction in the sagittal plane immediately. In the present study, one patient had a 45° anteflexion angle with a 10° extension lag at follow-up.

In terms of function and esthetics, with pin fixation the scores vary between 56% and 99% good and excellent results [19,23]. In our study we noted 80.6% very good results and 19.4% good results. Piggot et al. [2] noted 25% cubitus varus after treatment of Holmberg type III and IV extension-type SCFs.

Dowd and Hopcroft [24] and Labelle et al. [25] believe that cubitus varus does not result in functional deficiency and that the loss is only esthetic. Since the deformity is only obvious in complete extension, this implies that the patient has recovered complete mobility [26].

We found three cases (4.5%) of 10° cubitus varus in our study. The loss was only esthetic, with an adequate mobility range, explaining why they were not treated. The observations of Dowd and Hopcroft [24] and Labelle et al. [25] were thus confirmed concerning the cases of cubitus varus. In addition, the latter could correspond to good results according to most functional scores. Williamson and Cole [27] obtained 95% excellent results with the Blount method associated with strapping despite 22.7% cubitus varus.

In our study, we found a single case of myositis ossificans of the anterior brachial muscle, which resulted in flexion limited to 110°. The patient was seen 10 days after his injury, after having consulted a traditional practitioner. Like Clavert et al., we found no vascular or nerve complications [8].

Floating elbow most often follows a high-energy injury [28,29]. The supracondylar fracture is nearly always of the extension type and fracture of the two bones of the forearm is often in the distal quarter, sometimes resulting in type 2 epiphyseal detachment in the Salter and Harris classification [28,29]. The supracondylar fracture is nearly always of the extension type and fracture of the two bones of the forearm [28,29]. The supracondylar fracture is nearly always of the extension type and fracture of the two bones of the forearm [28,29].

The use of physical therapy is highly controversial in the literature [2]. For Sibly et al. [32], half of the patients treated by open reduction through the posterior approach require physical therapy. We did not make use of physical therapy in our study. Children’s propensity for play made it unnecessary. At follow-up, all patients had normal sectors of elbow mobility.

Conclusion

Highly displaced extension-type SCFs raises a therapeutic problem, with substantial swelling of the elbow that may be a source of vascular compression. Orthopaedic treatment with the Blount method, preceded if necessary by a short period of suspension provided very satisfactory results in our study. This effective method can be accessible to many institutions with an image amplifier available because it does not require any particular equipment. The lower cost and the absence of vascular and nerve complications as well as a shorter hospital stay make it a valuable alternative to pin fixation.

Conflict of interest statement

Nothing declared.

References


