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ORIGINAL ARTICLE

Experience and volume are determinantive factors for operative management of supracondylar humeral fractures in children

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Background: We compared radiographic and operative results of pediatric patients undergoing surgical treatment of displaced supracondylar humeral fracture (SCHF) according to the surgeon's experience.
Methods: During an 11-year period (2006-2016), we reviewed the medical records of 236 patients operated on for Gartland III SCHF in our institution. Operative (operative time, time to implants removal) and radiographic parameters (Baumann and lateral capitellohumeral angles) were assessed. A malalignment was defined if there was a difference in the Baumann angle or lateral capitellohumeral angles >15° or if malrotation existed compared with normative values. We compared surgeon experience and volume (number of patients operated on by year).
Results: In patients operated on by less experienced surgeons (<1 year, n = 69), operative time (61 vs. 41 minutes) and time to implant removal (48 vs. 40 days) were significantly longer ($P < .001$). Radiographic parameters did not differ between less and more experienced surgeons. Operative parameters improved through the 20 first cases of the younger surgeons. In surgeons managing fewer than 5 patients per year, malalignment and conversion to open reduction were more frequent (all $P < .05$).
Conclusion: Experience and volume are 2 crucial parameters influencing the quality of management of pediatric patients undergoing surgical treatment for displaced SCHF. They should be taken into account in daily practice, especially when making the decision to operate on these patients out of day time.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Supracondylar humeral fractures; children; experience; volume; operative management; learning curve; percutaneous pinning

Supracondylar humeral fractures (SCHF) are the most common fractures around the elbow in children and account for 3% to 6% of all fractures in children.[10,14,26] The surgical management of these fractures is part of the daily practice in pediatric orthopedics. The severity is based on the Gartland classification, according to the amount of displacement,[3,8] and surgical management is required for displaced fractures (ie, Gartland III) to obtain an anatomic reduction. Acceptable reduction, associated with remodeling phenomenon, currently leads to satisfactory functional outcomes.[4,24]

Obtaining an anatomic reduction and achieving a stable osteosynthesis can sometimes be challenging. Closed reduc-

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tion and percutaneous pinning have been described as the standard of care in the operative management of these patients.[24] Numerous factors, such as sex, fracture pattern, or pin configuration, have been reported to influence the outcomes.[9,13,19]

Only a few studies, however, report the role of experience in the management of these fractures.[10,15,18] Experience is a determinative factor for success in other orthopedic procedures, such as primary joint arthroplasties.[21] Because this type of fracture is currently managed in an urgent fashion, these patients are often treated by inexperienced surgeons.

We performed a retrospective cohort study to determine the role of experience in the management of SCHFs. We compared the operative and radiologic results of children undergoing percutaneous pinning for Gartland type III SCHF, according to the surgeon's experience.

Patients and methods

Study design

We performed a single-center retrospective review of medical records for every child admitted to our institution for a supracondylar fracture of the elbow classified as Gartland III from January 2006 to December 2016. Inclusion criteria were pediatric patients (age <18 years) who presented with an extension-type SCHF Gartland III and underwent surgical treatment. We excluded patients with extension-type fractures Gartland I and II, flexion-type fractures, complex intercondylar fractures, nonoperative management, or operative management with a technique other than percutaneous pinning. After the exclusion criteria were applied, 129 patients were excluded from the analysis, and 236 patients (130 boys and 106 girls; mean age, 6.4 years) remained.

Intervention

In every case, the standard of care was closed reduction and percutaneous pinning (CRPP). Every patient underwent up to 4 attempts of closed reduction to permit percutaneous pinning. If closed reduction failed, an open reduction with internal fixation (ORIF) was performed.

Four different techniques of CRPP were used, depending on the surgeon's preference: 2 lateral pins (n = 34), 2 lateral and 1 medial pin (n = 144), 1 lateral and 1 medial pin (n = 33), or 3 lateral pins (n = 25). When a medial pin was inserted, a minimally open approach was performed (2-cm skin incision) to avoid ulnar nerve injury. Cast immobilization was applied and removed after 3 to 4 weeks. None of the patients underwent physical therapy.

Data collection

The clinical and demographic variables collected were age, sex, follow-up, operative time, complications, and time to implant removal. A radiographic evaluation was performed from anteroposterior and lateral radiographs of the elbow postoperatively and at the last follow-up.

Radiographic parameters measured were the Baumann angle (defined as the angle between the axis of the humeral shaft and the axis of the growth plate of the capitellum on anteroposterior view) and the lateral capitellohumeral angle, defined as the angle between the axis of the humeral shaft and the axis of the humeral distal end on a lateral view (Fig. 1). A value of 70° for the Baumann angle and 40° for the lateral capitellohumeral angle were considered normative values.[20,23] A malalignment was diagnosed if there was a difference >15° with normative values for the Baumann angle or anteversion or if a malrotation existed (asymmetric reduction, based on the study of the medial and lateral columns).

Also collected was the surgeon's experience, defined as the number of years of practice at the time of the operation, and the cumulative number of patients operated on by each surgeon. Out-

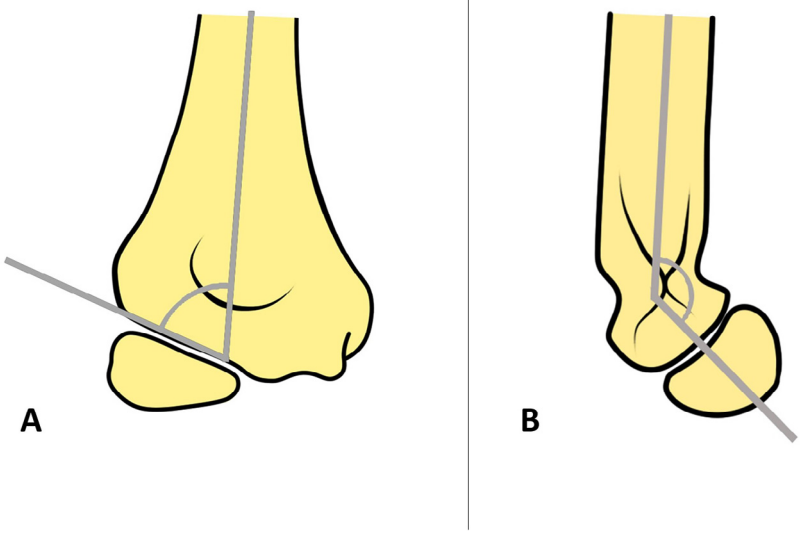

Figure 1 Measurement method for (**A**) Baumann angle on anteroposterior view and the (**B**) lateral capitellohumeral angle on lateral view.