MINIMALLY INVASIVE TREATMENT OF 56 CONSECUTIVE SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN

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Abstract

Objective: to present our results from the minimally invasive approach in the treatment of 56 consecutive Gartland types II and III supracondylar fractures of the humerus in school-age patients.

Method: Including criteria were isolated supracondylar fractures Gartland types II and III, in the period from January 2011 to November 2011. We admitted 56 children aged four to 12 years (mean 6.9 y.). The most common mechanism of injury was fall with the elbow extended. The treatment procedure consisted of four steps: 1) Classification of the injury according to x-ray findings; 2) Under general anaesthesia, the injured child was placed in a prone position; 3) Closed reduction was obtained by placing the elbow on a special table with the elbow flexed at 90 degrees, using gravity to help reposition; 4) After x-ray verification of the reduction two Sommer pins were inserted to stabilize the fracture. The pins were placed percutaneously through the medial and lateral humeral condyles respectively. After the intervention all elbows were immobilized in a splint cast for 3 weeks.

Results: All patients were followed up for six months. Control radiographs were performed postoperatively, three weeks and two months after the injury. There were no malunions or nonunions. We estimated the elbow function using the Mayo elbow performance index. The functional results were excellent and very good according to the Mayo score.

Conclusion: We recommend this one-day surgical approach for the treatment of Gartland type II and III supracondylar fractures.

Key words: supracondylar fractures, children, minimally invasive treatment.

Introduction

Supracondylar fractures are the most common type of elbow fractures which require hospital treatment [1–3]. Depending on the mechanism of injury and the direction of the distal fragment, there are two recognised fracture patterns: extension type (predominant, sustained in a fall on the outstretched arm with the elbow in full extension) and flexion type (1–3%; sustained in a direct fall on the elbow) [4]. Gartland’s classification scheme is the most prevalent in the literature and it is based on the radiographic appearance of the dislocation. It distinguishes three types of fractures: type I (nondisplaced); type II (fractures with intact posterior cortex) and type III (displaced fractures with no cortical contact) [5].

These fractures are usually accompanied with marked swelling which challenges the appropriate reduction and immobilisation [6, 7]. Many of these fractures are unstable after reduction except in an acutely-flexed position. If considerable swelling is present, the position may further compromise vascularity [8, 9]. Immobilization in the safer right-angle position will frequently allow the fragments to slip, producing various deformities and causing dilemmas in the treatment of displaced supracondylar fractures [10].
Type I fractures are a subject to conservative treatment. The treatment of type II and type III supracondylar fractures is the subject of discussion. This study presents our results from the minimally invasive approach in the treatment of 56 consecutive Gartland types II and III supracondylar fractures of the humerus in the school-age patients.

**Material and method**

Our study included only isolated supracondylar fractures types II and III according to the Gartland classification. Children with neurovascular injuries were excluded from the study. All children were treated at the University Pediatric Surgery Clinic, Skopje, from January 2011 to November 2011, in a period of 24 hours after sustaining the injury. The children were aged four to twelve years (mean 6.9 years). The most common mechanism of injury was a fall with the elbow extended during sports activities or outdoor play.

Under general anaesthesia, the patient was placed prone on the operating table and brought closer to the edge of the table at the injured side. Then a radiolucent board was slid beneath the patient at the level of the shoulders (Fig. 1). The board is designed so that the fractured elbow is supported by a pad. In this manner, with the elbow flexed at 90 degrees the forearm hangs loose and can be freely manipulated to achieve reduction. In this position gravity helps the reduction (Fig. 2). Adequacy of the reduction is confirmed using fluoroscopic images taken with the C-arm, both in antero-posterior and lateral directions. After confirmation, the fracture is stabilized with two Sommer pins. At our institution we cross-pin the fracture, placing one pin through the medial and one through the lateral condyle of the humerus (Fig. 3).

Proximally the pins are placed intramedullary, touching the opposite cortex. The pin position is verified with fluoroscopy, and thereafter the pins are shortened and bent (Fig. 4). The extremity was immobilised with a splint cast for a period of 3 weeks. Neurological examination of the injured extremity was performed 24 hours after the procedure, before discharge.

All patients were followed up for six months. Control radiographs of the elbow (anteroposterior and lateral views) were performed postoperatively, three weeks and two months after the injury. The pins were removed on an outpatient basis three weeks after the operation. No further immobilisation was applied. All patients went through a course of physical therapy.
Results
There were no conversions to open reduction and fracture fixation in this series. All interventions were performed as one-day surgeries. There were no pin infections and no iatrogenic nerve injuries. The treated fractures healed uneventfully, no malunions or nonunions were registered.

Table 1
The Mayo elbow performance score

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>POINTS</th>
<th>PATIENT SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAIN</td>
<td></td>
<td>= 45</td>
</tr>
<tr>
<td>None</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>RANGE OF MOTION</td>
<td></td>
<td>= 20</td>
</tr>
<tr>
<td>&gt; 100 degrees</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>50–100 degrees</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>&lt; 50 degrees</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>STABILITY (10 points)</td>
<td></td>
<td>= 10</td>
</tr>
<tr>
<td>Stable</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Moderate instability</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gross instability</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>DAILY FUNCTION (25 points)</td>
<td></td>
<td>= 25</td>
</tr>
<tr>
<td>Combing hair</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Feeding oneself</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hygiene</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Putting on shirt</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Putting on shoes</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Patient score</td>
<td>= 100</td>
<td></td>
</tr>
</tbody>
</table>

The functional results were estimated using the Mayo elbow performance index (Table 1). According to this scale patients were scored on the following criteria: pain, range of motion, elbow stability and ability to perform daily functions. The functional results were excellent in 30 children and very good in the remaining 26 children, according to the Mayo score.

Discussion
The reduction technique that we used in the treatment of supracondylar fractures differs from the most commonly used supine technique. The prone technique was introduced by Fowler et al. in 2006 [11]. They proposed several advantages to this technique. First of all, it averts the need to place the elbow in a hyperflexed position which is proved to have adverse effects on the forearm perfusion. Doppler measures show a diminishing of the radial pulse in the range of 70–130 degrees of elbow flexion [12], while compartment pressures rise with elbow flexion > 90 degrees, which was measured in vivo by Battaglia and Schwend. [13] In the prone position gravitation helps the reposition while the pad is a fulcrum at the anterior angulation. Therefore, the need to retain the position is avoided, and the procedure can even be performed without an assistant.

Numerous biomechanical and clinical studies have discussed the most stable method for percutaneous pinning of a supracondylar fracture. Theoretically the cross-pinning technique introduced by Swenson is the most stable bio-
mechanical construct [14]. The main point of concern is the iatrogenic injury to the ulnar nerve when placing a medial pin. Placing a medial pin is considered technically easier than placing a second or third lateral pin. The cubital tunnel is difficult to palpate in a swollen elbow [15], and > 50% of children aged 6 to 10 years demonstrate ulnar nerve hypermobility, namely the ulnar nerve in these children tends to displace anteriorly with elbow flexion [16]. The nerve can be injured directly with the pin, or indirectly by the tethering of the aponeurosis. Placing the pins with high rotational speed drags the aponeurosis and therefore exposes the nerve to damage [17]. For this reason at our institution the pins are placed using a T-handle. In this series no iatrogenic injury of the ulnar nerve was registered. Before placing the medial pin we found it prudent to make an effort to palpate the cubital tunnel, and the entry point of the medial pin should be medial to the tunnel.

Another point of discussion is whether the ends of the pins should be buried in the subcutis or left above the level of the skin. The main concern being the possibility of pin tract infection, which would further complicate healing. When the pins are buried, general anaesthesia is needed for the subsequent pin removal. We shortened and bent the pins above the level of the skin, which provides us with the opportunity to remove the pins on an outpatients basis. In our series no pin tract infection was encountered.

Conclusion

The percutaneous cross pinning of Gartland type II and III supracondylar fractures is being established as a routine procedure at our institution. The functional results from this series are excellent. We recommend this one-day surgical approach for the treatment of Gartland type II and III supracondylar fractures in school children.

REFERENCES

Резиме

МИНИМАЛНО ИНВАЗИВЕН ТРЕТМАН НА 56 КОНСЕКУТИВНИ СУПРАКОНДИЛАРНИ СКРШЕНИЦИ НА ХУМЕРУСОТ КАЈ ДЕЦА

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Целта на овој труд е да ги презентираме нашите резултати од минимално инвазивниот третман на 56 консекутивни Gartland тип II и III супракондиларни скршеници на хумерусот кај школски деца.

Метод: Во студијата беа вклучени изолирани супракондиларни скршеници Gartland тип II и III, третирани во периодот од јануари 2011 до ноември 2012. Примени се 56 деца на возраст од четири до дванасет години (средна возраст 6,9). Најчестото пострадување беше пад на испружена рака. Процедурата на третманот се состои од четири чекори: 1) Класификација на повредата според рентгенографскиот наод; 2) Поставување на детето на стомак по воведување во општа ендотрахеална анестезија; 3) Затворена репозиција со поставување на лактот во флексија од 90 степени со помош на специјално дизајниран држач и користење на дејството на гравитацијата за полесна репозиција; 4) Флуороскопска верификација на репозицијата и стабилноста на скршеницата со две Sommer-ови игли. Иглите беа поставувани перкутано низ медијалниот и латералниот кондил. По интервенцијата сите лакти беа имобилизирани со гипсена лонгета во период од три недели.

Резултати: Постоперативниот период на следење беше шест месеци. Контролните рентгенографии се правеа постооперативно, три недели и два месеци по повредата. Не се регистрирани незараснати или лошо зараснати скршеници. Функцијата на лактот ја проценуваме со помош на Mayo elbow performance index. Според оваа скала добиените функционални резултати беа одлични и многу добри.

Заклучок: Го препорачување овој еднодневен хируршки пристап во третманот на супракондиларните скршеници тип II и III според Gartland.

Ключни зборови: супракондиларните скршеници, деца, минимално инвазивен третман.