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Treatment of acute proximal humeral fractures in children with modular external fixator

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ABSTRACT

Objective: To evaluate the follow-up of the fractures treated by external fixator.
Methods: A total of 31 children aged 6–15 years with proximal humeral fractures Grade IV according to Neer–Horowitz classification were treated. The medium follow-up was 24 months.
Results: In all cases, a good stability of the fracture and a quick healing process were obtained. The mean time of follow-up was 24 months. The external fixation was removed after 6 weeks (5–8 weeks) on average. Constant shoulder score was proposed to all patients and the average result was 97.5 (84–100).
Conclusions: Advantages of the external fixation are rapid mobilization of the joint, low invasiveness, a single surgery and the possibility to correct any secondary displacement. It is important to underline that the positioning of external fixator should be implanted by expert surgeons and that the patients must cooperate during the entire process up to the time of the removal of the fixator.

1. Introduction

Proximal humeral fractures represent less than 1% of all the pediatric fractures and they include between 3% and 6% of slipped epiphyseal fractures[1,2]. Considering children aged between 5 and 12 years, these fractures are found mainly in teenagers. In the infant period, they are secondary only to clavicle fractures[3]. The mechanism of trauma differs according to the age of the patients. In infants, these fractures occur during passage through the birth canal, while in children, they occur as a consequence of falls on the hands in outstretched position. This kind of fracture usually does not cause a bone deformity, because the periosteum is thicker and has a high potential of remodeling in this region[4,5].

Pavone *et al.* proposed a classification based on the displacement of the fracture[6]. In the first grade, the displacement is up to 5 mm. In the second grade, the displacement is up to 1/3 of the diameter of humeral diaphysis. In the third grade, the displacement is up to 2/3. And in the fourth grade, it is over 2/3. The limit of this classification is that it does not considerate the angulation and the malrotation of the fragments.

The clinical evaluation is also correlated to the age of patients. In infants, there is crying with pseudoparalysis of the affected limb and in children, there are pain, swelling and decreased or absent motility with shortening of the limb. It is important to take into account the state of peripheral vessels and nerves[1].

The radiographic evaluation is done by RX images in two projections comparing the contralateral limb. In this study, only Grade IV fractures were included, as a consequence of an important grade of breakdown of the fracture. In many cases, a surgical treatment is necessary. The aim of this paper is to evaluate the results of the external fixators in the treatment of these types of fractures.

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The study protocol was performed according to the Helsinki Declaration. Informed written consent was obtained from all patients.

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2. Materials and methods

From January 2000 to January 2013, 31 children were treated with external fixation Hoffman II for proximal humeral fractures in Department of Orthopaedics and Traumatology, S.M. Misericordia Hospital in Perugia and U.O.C. Orthopedics and Traumatology, Azienda Ospedaliera "Gaetano Rummo" in Benevento. All these fractures belonged to Grade IV according to Neer and Horowitz classification.

Exclusion criteria were the following: pathological fractures, exposed fractures, fractures with vessel and nerve damage, Grade I, II and III according to Neer classification and polytrauma patients.

We did not lose any patients during the follow-up.

In all cases mentioned above, surgery was carried out within 24 h from the trauma with general anesthesia and beach chair position.

First, we performed a reduction through a longitudinal traction with abduction and extra-rotation of the limb under control of the brilliance amplification. In cases which the reduction was not acceptable, a proximal fiche was placed as a joystick. Open reduction and internal fixation were not necessary.

After the successful reduction of the fractures, two proximal fiches were first placed, then two distal ones connected with bars and clamps were placed. The fluoroscopy was checked in that there was no breakdown of the fracture, but there was passive mobilization of the shoulder and the R.O.M. was complete.

From the first day, post-operative patients were asked to perform active and passive mobilization of the shoulder. Radiographic controls were carried out on the day after the surgery, after 2 weeks and at the time to remove the external fixator (on average after 6 weeks). The removal of fiches was carried out with a mild sedation. For the evaluation of the results, the Constant score was used. The study was conducted in accordance with the ethical standards of the declaration of Helsinki and informed consent was obtained from all patients.

3. Results

Among 31 patients, 19 were males and 12 were females. In 18 cases, the right shoulder was involved, whereas in 14 of

Figure 1. Proximal humeral fracture.

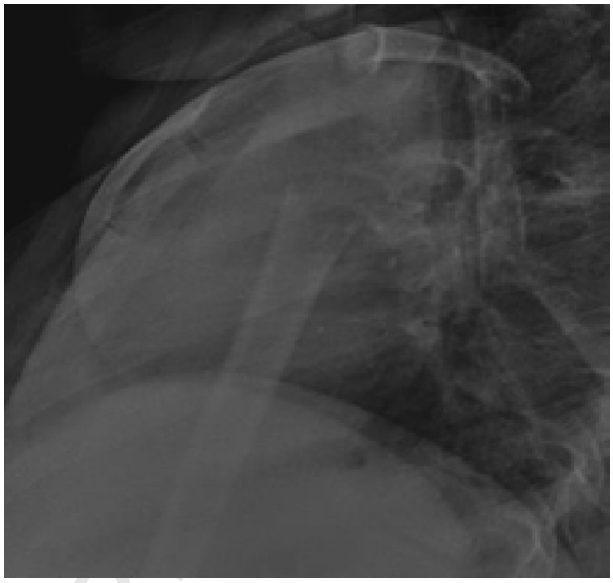

Figure 2. The important grade of displacement of the fracture.

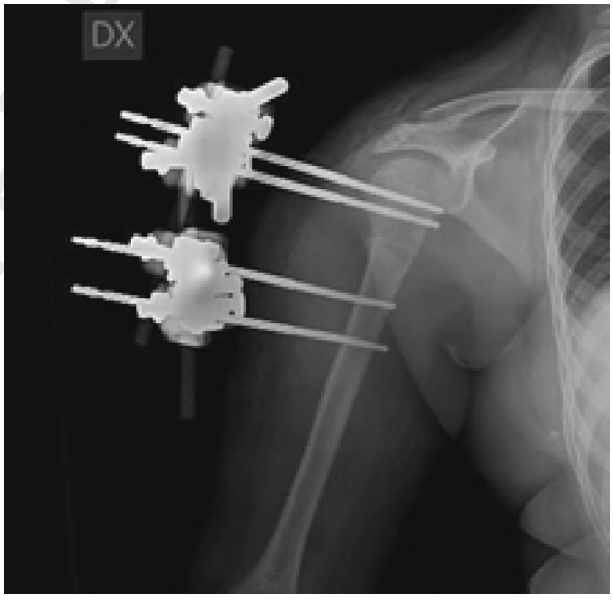

Figure 3. Post-operative image after the external fixation.

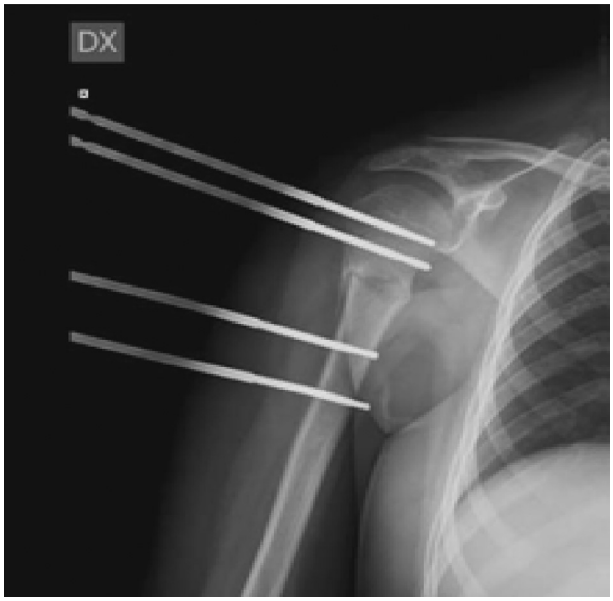

Figure 4. RX image in 6th weeks after the surgery, at the same time of removing the external fixator.