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A novel percutaneous intrafocal reduction technique for brachialis penetrating irreducible type 4 supracondylar humerus fracture

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Abstract

Type 4 supracondylar fractures are challenging to treat. Closed reduction may become impossible due to brachialis muscle penetration and devastating results like a neurovascular injury that may occur during recurrent manipulations. We here report an intra-focal percutaneous reduction technique for maintaining closed reduction. An extensively posterior displaced type 4 supracondylar fracture with a dimple at the antecubital fossa and an extensive ecchymosis is presented. During surgery, we could not obtain closed reduction with the milking maneuver. We inserted an intrafocal K-Wire from the posterior side into the fracture site. With the levering of the wire, the dimple disappeared, after which we maintained the anatomical reduction and fixed the fracture with two lateral K-wires. Neither complication nor residual deformity was observed during postoperative follow-up. To show the exact long-term effects and the safety of this procedure, we need more fractures with brachialis penetration operated on by the described technique.

Keywords: Brachialis penetration, Supracondylar, Humeral fracture, Closed reduction, Intrafocal reduction

Introduction

Multidirectional unstable supracondylar fractures are challenging for the treating orthopedic surgeons. Especially displacement through the brachialis muscle makes the treatment even harder [1]. Penetration of the muscle has a high incidence of neurovascular injury. The traditional technique to overcome the penetration is the milking maneuver. If this is not successful, open reduction with an anterior approach is considered to visualize the integrity of neurovascular structures and obtain anatomical reduction [2]. Type 4 supracondylar fractures are associated with longer surgical times, utilization of medial pin and increased levels of technical difficulty [3]. We here report a technical report to achieve closed reduction with minimal invasion to soft tissues.

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Informed Consent
The authors stated that the written consent was obtained from the parents of the patient presented with images in the study.

Conflict of Interest
No conflict of interest was declared by the authors.

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Case presentation

A five-year-old female patient was admitted to our Emergency Department by her parents after falling from a bicycle. Physical examination showed a gross deformity and ecchymosis at the antecubital fossa with a dimple in the skin. Due to brachialis muscle penetration, she had numbness in first and second digits. We applied an arm cast before any reduction and obtained roentgenograms (Figure 1). We decided on an urgent surgical intervention due to excess displacement and likelihood of neurovascular compromise. In the operation room, we attempted a gentle milking maneuver to obtain closed reduction but failed to pull the proximal diaphyseal fragment out from the brachialis muscle. Then we inserted a 2.00 mm Kirschner wire from the posterior side inside the triceps muscle towards the proximal fragment, directly into the fracture site. We attempted a leverage maneuver to overcome the penetration. As the dimple disappeared, we achieved an anatomical reduction and fixated the fracture with two lateral Kirschner wires in the traditional Jones position. The reduction and fixation were confirmed by the fluoroscopy (Figure 2). We applied a long arm cast for covering the fixation. The total surgery time was 10 minutes. The patient was discharged one day later as the swelling resolved and followed up postoperatively. Union was achieved in the 3rd week, at which point we took off the cast. The patient was started on gentle elbow range of motion exercises. In the fourth week, we removed the wires at the office then initiated stretching exercises. No residual deformity was seen postoperatively (Figure 3). The patient and her parents were content with the healing process. Informed consent was obtained from the patient's parents for the publication of this case report.

Figure 1: Preoperative clinical image of Pucker Sign and X-ray that demonstrates severely displaced type 4 supracondylar humerus fracture

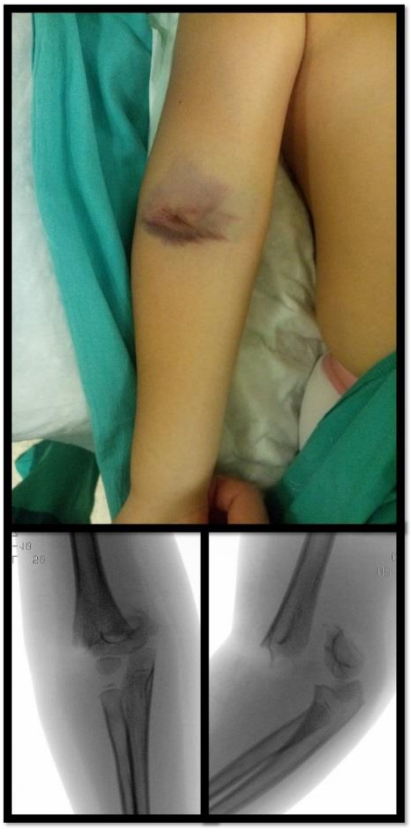


Figure 2: Peroperative x-rays, The application of the intrafocal pinning and fixation with 2 lateral K-Wires.

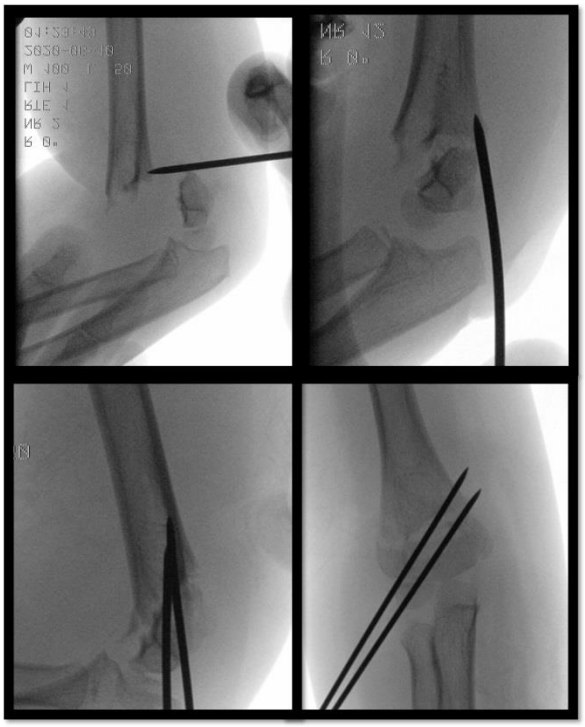
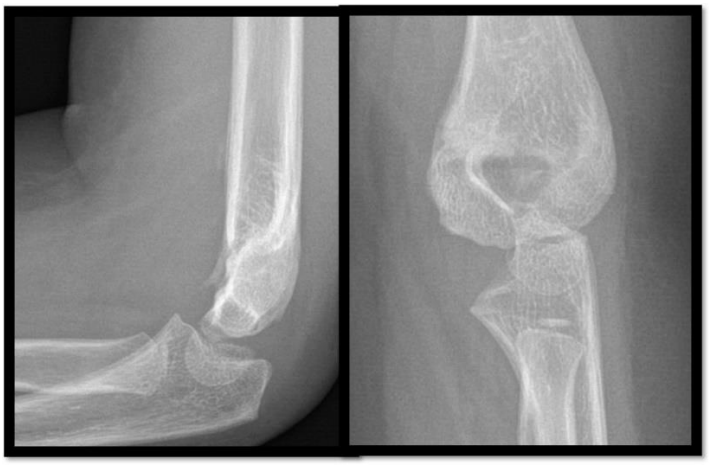


Figure 3: Postoperative late (6th week) X-ray



Discussion

Type 4 supracondylar fractures are challenging to treat, and they are associated with a longer operative time, and a higher likelihood of open reduction [4]. Joystick maneuver is the generally preferred technique for reduction of the distal fragment [1, 2, 5]. With this technique, if lateral views are obtained by rotating the C-arm (instead of rotating the arm), the loss of reduction can be avoided [1, 5]. Silva et al. have described similar results with the same technique by rotating the arm with less effort [2]. When the brachialis muscle is penetrated, the proximal fragment may become entrapped in the antecubital fossa. There is also a high incidence of brachial artery and median nerve injury due to entrapping [6]. The well-known traditional technique, the "Milking maneuver," was described by Peters et al [3]. They attempted the technique in eight patients and achieved successful closed reduction in all without any complications. Archibeck et al. [7] used this method in 16 patients but they could not obtain closed reduction in one patient. Closed reduction may become impossible due to the penetration and devastating results may occur during recurrent

manipulations. It is not recommended to attempt manipulations more than twice [6]. Open reduction with the anterior approach is utilized to get rid of the interposing brachialis muscle directly and to confirm the continuity of neurovascular structures if closed reduction could not achieved [8].

There are different suggestions in the current literature regarding the number and placement of wires applied after closed reduction. Crossed pin constructs had shown superior fracture stability than the divergent lateral pin fixation in biomechanical studies. However, there was no difference between these techniques in terms of loss of fracture reduction. Guven et al. [9] retrospectively evaluated pediatric lateral condylar fractures with divergent and parallel pins. They concluded that there was no difference in the radiologic results between these methods. We tend to perform divergent Kirschner wires, as in our case, the reduction was secured by two divergent wires with less than 60-degree angles to each other.

The ratio of closed reduction was very low in the previous reports when pucker sign (buttonholing of proximal fragment through brachialis muscle) was present [2, 4, 5]. With our described technique, we could still obtain the closed reduction and reduce the need for the open reduction to avoid complications even if the milking maneuver was not successful. We need more patients with pucker sign to document the safety and efficacy of this method.

Conclusion

The described technique may become a primary alternative to the milking maneuver to obtain closed reduction of pediatric supracondylar humerus fractures and reduce the open reduction rates as well as complications due to the open approach.

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