TECHNICAL NOTE

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A new method to correct rotational malalignment for closed reduction and percutaneous pinning in pediatric supracondylar humeral fractures

Ali TURGUT[1], Ahmet Murat AKSAKAL[2], Alpaslan ÖZTÜRK[2], Savaş ÖZTAŞ[2]

[1]Tepecik Training and Research Hospital, Department of Orthopedics and Traumatology, Izmir, Turkey;
[2]Şevket Yılmaz Training and Research Hospital, Department of Orthopedics and Traumatology, Bursa, Turkey

Open reduction is often necessary for the treatment of supracondylar humeral fractures in children in which rotational malalignment cannot be corrected by closed means. We introduce a new closed reduction technique for the correction of this deformity using a Kirschner wire as a joystick.

Key words: Closed reduction; rotational malalignment; supracondylar humeral fracture.

Supracondylar humeral fractures usually occur after falls onto an outstretched hand with the elbow in full extension.[1] The anterior periosteum is torn while the posterior periosteum is intact. The majority of these fractures are extension-type and usually classified according to the Gartland classification system. In Gartland Type 3 fractures, the periosteum is usually circumferentially torn. Rotation is almost always a feature of this type of fracture and if rotation is not corrected, the distal fragment leads to gunstock deformity and cubitus varus deformity.[2] Horizontal rotation in a medial direction or internal rotation of the distal fragment is believed to predispose the distal fragment's varus angulation.[3] The main aim in the treatment of these injuries is reducing the fracture, correcting any rotational deformity, maintaining reduction and preventing complications.[4] To achieve reduction, hyperflexion of the elbow is usually successful for sagital plane deformity but correction of the external rotation deformity of the proximal fragment can be difficult due to the instability of the fragments and edema of the elbow.

A method was required to correct the rotational deformity by opening the fracture from the lateral side of the elbow and internally rotating the proximal fragment with a bone clamp. The authors hypothesized that this maneuver could be performed using a Kirschner wire (K-wire) as a joystick by closed means.

The aim of this study was to illustrate this simple method for the correction of rotational malalignment by closed means without any iatrogenic nerve injury.

Patients and methods

The study included a total of 19 children (mean age: 7 years and 6 months, range: 3 years and 2 months to 12 years and 10 months) with Gartland Type 3 supracondylar humerus fractures treated with closed reduction using a K-wire as a joystick between June 2011 and January 2013. Rotational deformity could not be corrected by other means.

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Correspondence: Ali Turgut, MD. Tepecik Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, Güney Mah. 1140/1 Sok. No: 1, Yenişehir, Konak, Izmir, Turkey.
Tel: +90 537 - 027 44 25 e-mail: draliturgutort@yahoo.com.tr

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Patients were positioned in the supine position on the operating table under general anesthesia. After longitudinal traction, the elbow was hyperflexed. Anteroposterior position of the reduction was seen in the Jones position. Two parallel K-wires were used laterally to stabilize the fracture. The position of the fracture was then checked on the image intensifier and correction of any rotational deformity was attempted by rotating the arm internally. In cases in which the malalignment could not be corrected through internal rotation of the arm, a 3.0 K-wire was inserted from the posterolateral side transversely to approximately 1 to 1.5 cm proximal to the fracture line (Fig. 1a). The two K-wires inserted before were then withdrawn (Fig. 1b). After applying longitudinal traction and hyperflexion to the elbow, the arm was internally rotated on the image intensifier. By manipulating the transverse K-wire (turning it inward), rotational malalignment was corrected (Fig. 1c, d). Two K-wires were inserted from the lateral side and rotational stability was achieved (Fig. 1e). The arm was rotated externally and the flexion was lessened to protect the ulnar nerve. An additional K-wire was inserted from the medial epicondyle and checked on anteroposterior and lateral views.

Procedures were performed by three different surgeons. At final examination, the carrying angles of both elbows were measured using a goniometer and angle differences were reported as minus or plus according to the uninjured side. The range of motion of the uninjured elbow was measured using a goniometer.

Results

Average follow-up time was 13.3 (range: 7 to 22)

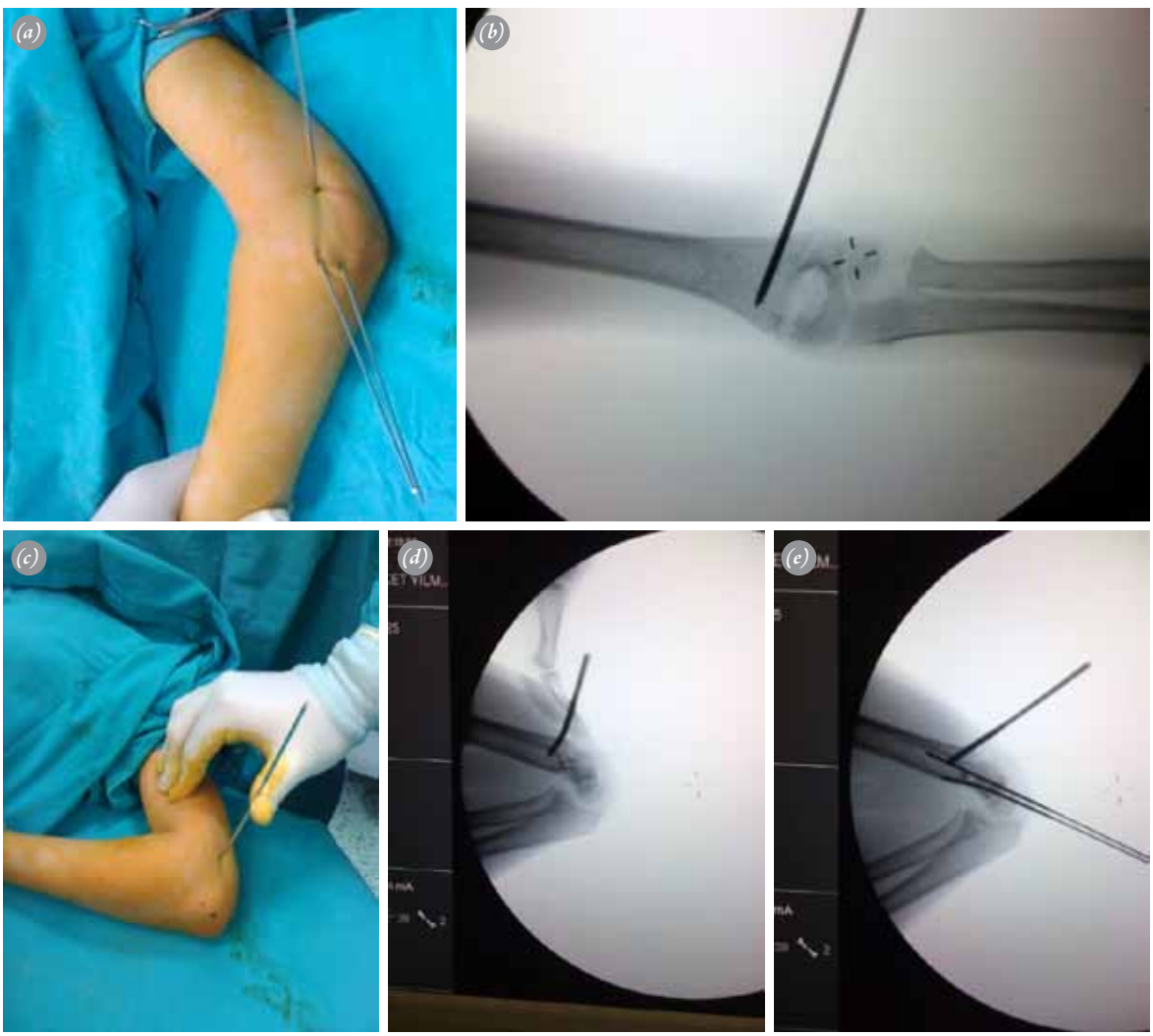

Fig. 1. **(a)** Inserting the joystick K-wire. **(b)** Position of the joystick K-wire. **(c, d)** Manipulating the joystick K-wire and correction of the rotational deformity. **(e)** Stabilizing the fracture from the lateral side. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Table 1. Patients' ages, follow-up times, and functional and cosmetic results.

Patient	Age	Follow-up time	Extension	Flexion	Carrying angle difference
1	4 years	22 months	-10°	150°	-2°
2	6 years and 2 months	22 months	0°	150°	0°
3	5 years and 6 months	19 months	+5°	145°	+2°
4	9 years	18 months	0°	150°	-5°
5	6 years and 3 months	18 months	0°	140°	-2°
6	8 years and 9 months	17 months	+5°	150°	+4°
7	4 years and 4 months	15 months	0°	150°	0°
8	3 years and 2 months	15 months	-5°	150°	+2°
9	12 years and 4 months	15 months	0°	150°	+2°
10	8 years and 7 months	12 months	0°	150°	0°
11	10 years and 2 months	12 months	0°	150°	-2°
12	5 years and 3 months	10 months	+10°	140°	+2°
13	4 years and 2 months	10 months	0°	155°	-4°
14	7 years and 2 months	9 months	+5°	145°	+2°
15	8 years	8 months	+5°	150°	0°
16	12 years and 10 months	8 months	0°	150°	-2°
17	10 years and 2 months	8 months	+10°	150°	-2°
18	9 years and 3 months	8 months	0°	150°	0°
19	8 years and 3 months	7 months	+5°	150°	0°

months. At the final examination, mean elbow flexion-extension range of motion arc was 146° (range: 130° to 160°). Carrying angle decreased in 7 elbows, increased in 6 and remained the same in 6 (Table 1). There was no radial nerve palsy as a result of inserting the joystick K-wire.

Discussion

The classical reduction maneuver for extension-type supracondylar humeral fracture in children is first longitudinal traction and then hyperflexion of the elbow. The forearm can be either in supination or pronation according to the side of displacement. In some cases, varus-valgus angulation and hyperextension deformity can be corrected while correction of the rotational deformity is unsuccessful. In these cases, internal rotation must be applied to the arm due to the external rotation of the proximal fragment. However, such a manipulation does not work in some cases.

In our practice, it could be observed that the open procedure for such fractures was performed due to inability to correct rotational deformity by internally rotating the arm. In these open reductions, the proximal fragment was internally rotated to achieve reduction. Two reports in the literature have described the use of K-wire as a joystick to correct rotational deformity. Parmaksizoglu et al. described a method using a K-wire inserted in the proximal humerus as a joystick.[5] Recently, Novais et al. described another method in which a K-wire was inserted to the distal fragment as a joystick to facilitate reduction.[6] While Parmaksizoglu's method had the low risk of iatrogenic nerve injury; the need for an incision and the joystick's distance from the injury side for manipulation can be considered disadvantages of the method. The advantage of Novais et al.'s method was the easy control of the distal fragment while disadvantages were the insertion of the joystick in a relatively soft metaphyseal bone which could serve as a barrier to the fixating K-wires.

Parmaksizoglu et al. inserted the K-wire far from the fracture side (near the deltoid insertion).[5] We hypothesized that if we inserted the wire near the fracture, we could more easily achieve correction. In our patients, we inserted the wire 1 to 1.5 cm above the fracture line. Novais et al. described their new technique in a series of 8 patients in which a K-wire was inserted into the distal fragment and the distal fragment was manipulated.[6] As the distal portion of the fracture is relatively soft metaphyseal bone, manipulation of this bone with a K-wire can produce comminution.

Closed reduction and percutaneous pin fixation is preferable over open reduction and pin fixation because of the lower complication rates.[7-9] According to some authors, malrotation of the fracture is not significant as it can be compensated for by the wide rotational motion of the shoulder. Although true, in insufficiently reduced

malrotated supracondylar fractures, the very thin proximal and distal portions of the olecranon fossa oppose each other.

The radial nerve passes the spiral groove and then turns anteriorly. This nerve pierces the lateral intermuscular septum and lies between the brachialis and brachioradialis muscles. Guse and Ostrum showed that the radial nerve does not pass within 100 mm to the lateral epicondyle.[10] In our technique, attention must be paid to avoid radial nerve injury in high level fractures. In low level fractures, inserting the wire posterolaterally and passing the far cortex is a safe method. None of our 19 patients experienced radial nerve palsy complication.

Primary treatment of displaced supracondylar humeral fractures in children is closed reduction and percutaneous pinning. This method has the advantages of short operation and hospitalization time, low infection rates, and preservation of the fracture hematoma.[11] Therefore, it is important to achieve acceptable reduction by closed means.

This new procedure was performed by three different surgeons in the same clinic and all achieved satisfactory reduction and final elbow function. At the final examination, all patients and parents were satisfied with the functional and cosmetic results.

The simplicity of our method and the fact that it can be used without any complications if performed properly can be considered the strengths of this study. However, the disadvantage of our study is that we did not time our perioperative fluoroscopy usage; such a record would allow for evaluation of radiation exposure and comparison with other closed reduction techniques as mentioned in the literature.

In conclusion, our technique appears to be a simple procedure for the correction of rotational malalignment during closed reduction that can lessen operation time, remove the need for open reduction and be performed by all surgeons.

Conflicts of Interest: No conflicts declared.

References

1. Charnley J. Arthroplasty of the hip. A new operation. Lancet 1961;1:1129-32. CrossRef
2. Crombie R, Duncan R. Closed reduction and percutaneous fixation of displaced paediatric supracondylar fractures of the elbow. Curr Orthop 2004;18;147-53. CrossRef
3. Kasser JR, Beaty JH. Supracondylar fractures of the distal humerus. In: JR Kasser, JH Beaty, editors. Rockwood and Wilkins' Fractures in Children. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006. p.575.
4. Tellisi N, Abusetta G, Day M, Hamid A, Ashammakhi N, Wahab KH. Management of Gartland's type III supracondylar fractures of the humerus in children: the role audit and practice guidelines. Injury 2004;35:1167-71.
5. Parmaksizoglu AS, Ozkaya U, Bilgili F, Sayin E, Kabukcuoglu Y. Closed reduction of the pediatric supracondylar humerus fractures: the "joystick" method. Arch Orthop Trauma Surg 2009;129:1225-31. CrossRef
6. Novais EN, Andrade MA, Gomes DC. The use of a joystick technique facilitates closed reduction and percutaneous fixation of multidirectionally unstable supracondylar humeral fractures in children. J Pediatr Orthop 2013;33:14-9. CrossRef
7. Lee SS, Mahar AT, Miesen D, Newton PO. Displaced pediatric supracondylar humerus fractures: biomechanical analysis of percutaneous pinning techniques. J Pediatr Orthop 2002;22:440-3. CrossRef
8. Reitman RD, Waters P, Millis M. Open reduction and internal fixation for supracondylar humerus fractures in children. J Pediatr Orthop 2001;21:157-61. CrossRef
9. Aktekin CN, Toprak A, Ozturk AM, Altay M, Ozkurt B, Tabak AY. Open reduction via posterior triceps sparing approach in comparison with closed treatment of posteromedial displaced Gartland type III supracondylar humerus fractures. J Pediatr Orthop B 2008;17:171-8. CrossRef
10. Guse TR, Ostrum RF. The surgical anatomy of the radial nerve around the humerus. Clin Orthop Relat Res 1995;320:149-53.
11. Mazda K, Boggione C, Fitoussi F, Penneçot GF. Systematic pinning of displaced extension-type supracondylar fractures of the humerus in children. A prospective study of 116 consecutive patients. J Bone Joint Surg Br 2001;83:888-93. CrossRef