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Closed reduction using the percutaneous leverage technique and internal fixation with K-wires to treat angulated radial neck fractures in children-case report

Hai Jiang, MD[a], Yongtao Wu, MD[b], Youting Dang, MD[b], Yusheng Qiu, PhD[a,*]

Abstract

Pediatric radial neck fractures are uncommon. Severely displaced and angulated fractures usually require treatment. Our goals for treatment are to avoid incision, reduce the fracture adequately with no reduction loss, and achieve good postoperative function. We aimed to observe the clinical outcomes of closed reduction with the percutaneous leverage technique and internal fixation with Kirschner-wires (K-wires) to treat angulated radial neck fractures in children.

From January 2011 to April 2013, we treated 16 cases of angulated radial neck fracture in 12 boys and 4 girls. Five fractures were type II and 11 fractures were type III using the O'Brien classification. One K-wire was percutaneously introduced into the fracture site using the leverage technique to attain good reduction. Two K-wires were introduced from the proximal to the distal areas of the fracture site. The elbow was immobilized by cast in 90° of flexion and the forearm in supination for 3 to 4 weeks. The K-wires were removed at 3 to 4 weeks postoperatively. All cases were followed up for a mean duration of 3 years 6 months.

According to the Metaizeau reduction classification, 12 cases were excellent, and 4 cases were good. According to the Metaizeau clinical classification, 14 cases were excellent, and 2 cases were good. There was no necrosis of the radial head. There was no infection, radioulnar synostosis, and damage of the radial nerve deep branch. There was no limitation in the pronation and supination functions of the forearm.

Closed reduction using the percutaneous leverage technique and internal fixation using K-wires is easy to perform. It is encouraged to use this approach as the clinical outcome is good.

Level of evidence: level IV-retrospective case, treatment study.

Abbreviation: K-wire = Kirschner wire.

Keywords: children, closed reduction, internal fixation, leverage technique, radial neck fracture

1. Introduction

Radial neck fractures in children are relatively uncommon. The incidence is about 1% among fractures occurring in all children. The treatment of displaced and angulated fractures remains a challenge. Many techniques are performed and have been published to treat displaced and angulated fractures. These techniques include closed reduction, percutaneous pin reduction, intramedullary pin reduction with elastic stable intramedullary nailing or Kirschner-wires (K-wires), and open reduction with or without internal fixation. Open reduction is indicated to treat a completely displaced radial neck fracture. However, there is a high incidence of complications associated with open reduction. A secondary displacement may occur following closed reduction without internal stabilization.

Our goals for treatment are to avoid incision, reduce the fracture adequately with no reduction loss, and achieve good postoperative function. We performed a closed reduction with a percutaneous leverage technique and internal fixation method with K-wires to treat angulated radial neck fractures in children.

2. Methods

From January 2011 to April 2013, we treated 16 cases of angulated radial neck fractures in 12 boys and 4 girls. The types of fractures categorized by the O'Brien classification as follows: type I – angulation <30°; type II – angulation 30–60°; and type III – angulation >60°. Among our patients, 5 had type II and 11 had type III fractures. The patient age ranged from 5 to 15 years. The average age was 8 years 4 months. The left side was affected in 9 cases, right side was affected in 7 cases. Complications with ulnar olecranon fracture and medial epicondyle fracture were present in 3 cases and 2 cases, respectively. No blood vessel or nerve trauma was evident. The shortest time from trauma to surgery was 4 hours and the longest time was 6 days.

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[a] Department of Orthopedics, The First Affiliated Hospital of Xi'an Jiao Tong University, [b] Department of Pediatric Orthopedics, Honghui Hospital, Xi'an Jiaotong University College of Medicine, Xi'an, Shan'xi, China.

[*] Correspondence: Yusheng Qiu, Department of Orthopedics, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, Shan'xi, China (e-mail: yusheng.qiu@mail.xjtu.edu.cn).

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2.1. Surgical technique

General anesthesia was induced or a brachial plexus block applied. The supine positioned was maintained by the patient throughout surgery. A 1.6- or 2.0-mm K-wire was inserted from distal to proximal of the elbow percutaneously. In this procedure, the K-wire was inserted into the fracture site. The K-wire was used to lever the fracture and to orient the proximal part horizontally with the lateral condyle plane. The reduction position was confirmed by intraoperative fluoroscopy (Fig. 1A, B). After a good reduction was attained, two 1.2 mm K-wires were percutaneously inserted from the articular surface through the fracture site to the opposite cortex for fixation (Fig. 1C,D). During the internal fixation, the K-wire used for leverage should be held. The outside part of the K-wire was cut after internal fixation. The 3 cases with ulnar olecranon fractures were not treated because there was no obvious displacement. We performed open reduction in the 2 cases with medial epicondyle fractures. These were internally fixed with K-wires. Our research was approved by the Biomedical Research Ethics Committee of Hong Hui Hospital, Xi'an Jiaotong University College of Medicine.

A long-arm cast or brace was used for 3 to 4 weeks after the procedures, with the elbow in 90° of flexion and the forearm in supination. The K-wires were removed before starting rehabilitation exercise.

3. Results

Cases were followed up for an average of 3 years 7 months (range 2 years 6 months to 4 years 10 months). The postoperative reduction was assessed by roentgenograph within 1 week after surgery. No infection or nerve damage occurred in the short-term follow-up. No radial head necrosis or synostosis of the proximal ulna and radius was seen in the long-term follow-up. There was no secondary displacement. There was no disclosure of the epiphysis or valgus of the elbow during the follow-up.

According to the Metaizeau reduction classification,[1] 12 cases were excellent, and 4 cases were good. According to the Metaizeau clinical classification,[2] 14 cases were excellent, and 2 cases were good. There was 1 typical case with an excellent postoperative outcome (Fig. 2A–F).

4. Discussion

The appropriate treatment of pediatric radial neck fractures is controversial. Most authors agree that fractures with slight angulation should be treated conservatively, but severely angulated fractures (>60°) require further treatment with different methods.[3] However, more complications will be seen when operative management is required.[4] The complications of these fractures reported in children include avascular necrosis, early physeal closure, elbow stiffness, periarticular ossification, and overgrowth of the radius head.

The prognosis was not only related with the angulation of the radial neck fracture, but also with the age of the patient and extent of trauma. Metaizeau[2] suggested that a residual tilt above 10° to 15° at 10 to 12 years of age or 20° to 30° at a younger age could not be remodeled by growth. Additionally, Bernstein[5] found that the determination of what constituted a significant angulation vari with the child's age, with greater angulation degrees acceptable for younger children.

The compression and impaction extends to the lateral side of radial neck upon radial neck fracture. The redisplacement will be accomplished easily only if it is immobilized by cast as there is no support from the lateral portion of the radial neck for the radius head after reduction. Steinberg[6] reported that 22 cases which occurred redisplacement in whole 28 cases which were immobilized by cast after reduction. Thus, a suitable internal fixation can prevent redisplacement following a good reduction. This is very important for the recovery of the postoperative function.

There are 3 primary methods for treating pediatric radial neck fracture. One method uses an elastic stable intramedullary nailing to indirectly reduce and fix the fracture site.[7] The other method uses an intramedullary K-wire to perform indirect reduction and internal fixation.[8] The 3rd method uses a percutaneous K-wire to perform direct reduction and internal fixation.[9]

In comparing the 3 different methods, some authors[10–12] recommended closed reduction and elastic intramedullary fixation to treat a fracture of the radius in children. However, we found that it was difficult to reduce the displaced radius head through rotating the distal part of the elastic intramedullary nail. This reduction approach usually requires an assistant to manipulate the percutaneous K-wire. It is challenging to fix the radial head with elastic intramedullary nail after a good

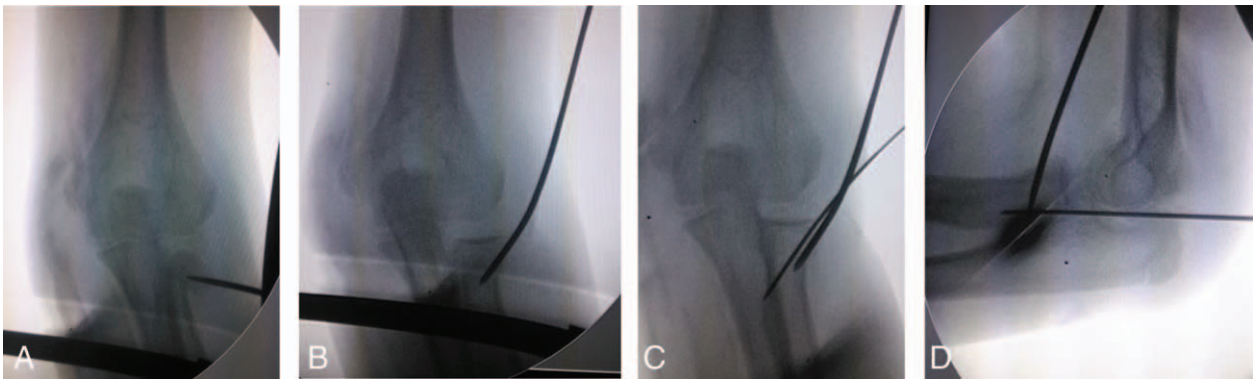

Figure 1. (A) The Kirschner wire (K-wire) was inserted percutaneously into the fracture site. (B) The inserted K-wire was used as a lever to reduce the fracture. (C) One 1.2 mm K-wires was percutaneously inserted from the articular surface passing through the fracture site to the opposite cortex. (D) The lateral film showed the position of K-wire suitable. Typical case: femail, 12 years old, and right side.

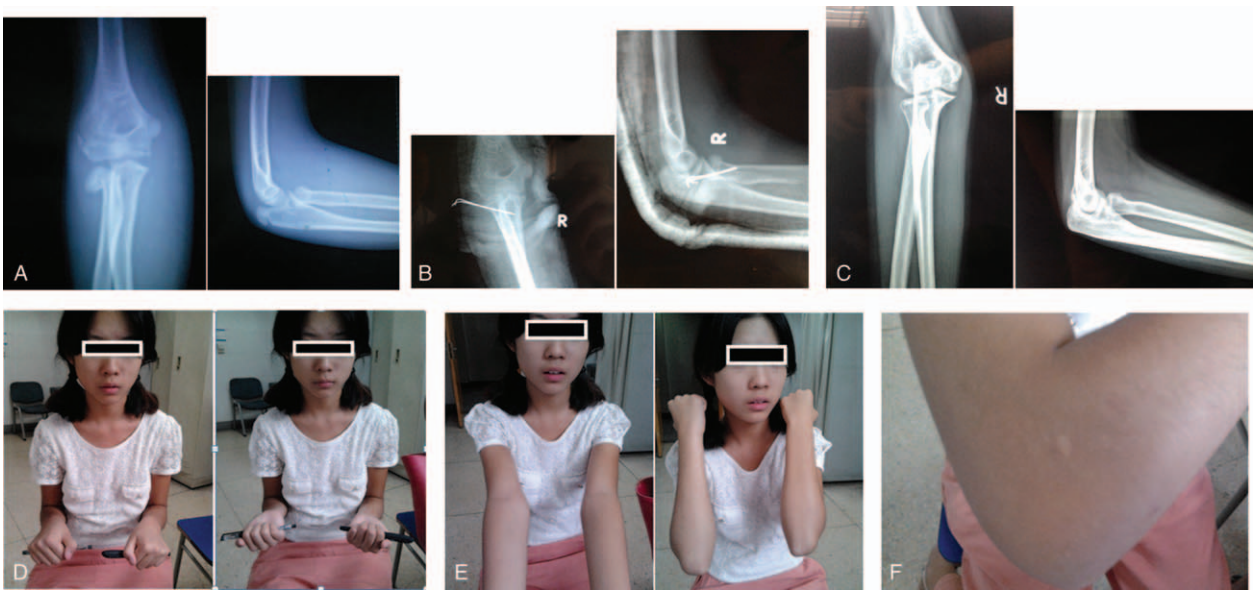

Figure 2. (A) The preoperative X-ray showed the severe tilt and displacement of radial neck. (B) The postoperative X-ray showed the reduction excellent. (C) The 2 years later follow-up X-ray picture showed the radial head normal. (D) The supination and pronation function of the forearm was normal. (E) The flexion and extension function of the elbow was normal. (F) The scar of the needle site was very small.

reduction. The radial head was easily separated from the fracture site when penetrating with and rotating the nail. There was a large distance within the fracture site. The functional lever arm was too long when the elastic intramedullary nail or intramedullary pin was used to fix the radial head. It was challenging to maintain a good position. Eberl[13] reported 42 cases that were treated with an intramedullary K-wire. A reduction loss occurred in 7 cases after surgery. We fixed the fracture site using percutaneous K-wires at the proximal site. The lever arm was short and therefore it could stabilize the fracture site. Redisplacement could no longer occur easily. In this group, there was no redisplacement after surgery.

Some authors were concerned about epiphyseal damage when fixing with K-wires. We used two or three 1.2 mm K-wires for percutaneous fixation. There was no disclosure of the epiphysis or valgus of the elbow during the follow-up. There are many advantages to using this method. Trauma was minor and there was no interference with the blood supply of the radial head. There was no postoperative scarring and the patients and their parents were satisfied with outcome. The K-wires were removed in the out-patient clinic. No case required a 2nd in-patient treatment. The cost was decreased.

There are some aspects that should be addressed. The insertion site should be carefully selected to avoid damage to the deep branch of the radial nerve. The anatomic reduction should not be resisted. Mild angulation and displacement could be remodeled in the growth. The trauma may be increased when repeated reductions are performed. The K-wires should be appropriately sized, with a diameter no greater than 1.5 mm. We usually choose 1.2 mm K-wires to prevent damage to the epiphysis. The fixation should pass through the internal cortex of the proximal radial neck.

5. Conclusions

We recommend the percutaneous leverage technique during closed reduction and internal fixation using K-wires for the treatment of angulated radial neck fractures in children. This is a simple method with little trauma to the patient and a satisfactory clinical outcome.

References

[1] Metaizeau JP, Lascombes P, Lemelle JL, et al. Reduction and fixation of displaced radial neck fractures by closed intramedullary pinning. J Pediatr Orthop 1993;13:355–60.
[2] Metaizeau JP. Reduction and osteosynthesis of radial neck fractures in children by centromedullary pinning. Injury 2005;36:S-A75–7.
[3] Falciglia F, Giordano M, Aulisa AG, et al. Radial neck fractures in children: results when open reduction is indicated. J Pediatr Orthop 2014;34:756–62.
[4] De Mattos CB, Ramski DE, Kushare IV, et al. Radial neck fractures in children and adolescents: an examination of operative and nonoperative treatment and outcomes. J Pediatr Orthop 2016;36:6–12.
[5] Bernstein SM, McKeever P, Bernstein L. Percutaneous reduction of displaced radial neck fractures in children. J Pediatr Orthop 1993;13:85–8.
[6] Steinberg EL, Golomb D, Salama R, et al. Radial head and neck fractures in children. J Pediatr Orthop 1988;8:35–40.
[7] Prathapkumar KR, Garg NK, Bruce CE. Elastic stable intramedullary nail fixation for severely displaced fractures of the neck of the radius in children. J Bone Joint Surg [Br] 2006;88-B:358–61.
[8] Ugutmena Ender, Ozkana Korhan, Ozkanb Feyza Unlu, et al. Reduction and fixation of radius neck fractures in children with intramedullary pin. J Pediatr Orthop B 2010;19:289–93.
[9] Cha SM, Shin HD, Kim KC, et al. Percutaneous reduction and leverage fixation using K-wires in paediatric angulated radial neck fractures. Int Orthop 2012;36:803–9.
[10] Klitscher D, Richter S, Bodenschatz K, et al. Evaluation of severely displaced radial neck fractures in children treated with elastic stable intramedullary nailing. J Pediatr Orthop 2009;29:698–703.
[11] Klitscher Daniela, Richter Steffen, Bodenschatz Karl, et al. Evaluation of severely displaced radial neck fractures in children treated with elastic stable intramedullary nailing. J Pediatr Orthop 2009;29:698–703.
[12] Kruppaa C, Königshausen M, Schildhauer TA, et al. Isolated pediatric radial head and neck fractures. A rare injury. Analysis and follow up of 19 patients. Injury 2015;46(Suppl 4):S10–6.
[13] Eberl R, Singer G, Fruhmann J, et al. Intramedullary nailing for the treatment of dislocated pediatric radial neck fractures. Eur J Pediatr Surg 2010;20:250–2.