Chinese Journal of Traumatology 21 (2018) 301–303

Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: http://www.elsevier.com/locate/CJTEE

Original Article

Palmar approach with Kirschner-wire fixation in the treatment of children's distal radius extension type fracture

Zu-Jie Hu, Ming Li, Xing Liu, Chuan-Kang Liu*

Department of Pediatric Orthopaedic Ward 1, Children's Hospital of Chongqing Medical University, Chongqing 400014, China

ARTICLE INFO

Article history:
Received 21 May 2018
Received in revised form
29 August 2018
Accepted 2 September 2018
Available online 4 October 2018

Keywords:
Radius fractures
Palmar approach
Kirschner-wire fixation
Children

ABSTRACT

Purpose: To explore the advantages of palmar approach with Kirschner-wire (K-wire) fixation in the treatment of children's distal radius extension type fracture.

Methods: Thirty patients, average age of 8.5 years ranging from 5 to 13 years, with distal radius extension type fracture and undergoing a failed manual reposition in our hospital were included, and treated by palmar approach with K-wire fixation between May 2014 and December 2017. Among these patients (21 male and 9 female), 5 patients had chronic injuries over 10 days, and 6 patients had fracture of the distal radius epiphysis. The time between injury and treatment ranged from 1 to 30 days. Among them, 11 patients with right-sided fractures and 19 patients with left-sided fractures were operated via the palmar longitudinal incision approach.

Results: The results were evaluated after an average of 18 months ranging from 5 to 36 months after operation. The recovery time of fracture was from 4 to 8 weeks and all incisions were primary healing with an average of 6 weeks. Nonunion, delayed union, early closure of distal radial epiphysis, and wrist varus/valgus deformity were not found in all the cases. Based on Gartland and Wereley wrist score assessment undertaken three months after operation, excellent scores were achieved in 24 cases, good scores in 3 cases, acceptable scores in 3 cases.

Conclusion: The palmar approach with K-wire fixation via a front longitudinal incision in the treatment of children's distal radius extension type fracture has following advantages: (1) easy to reposition for both fresh and old fractures; (2) less damage to surrounding tissues and epiphysis; (3) quick recovery. It is suitable to treat children's distal radius extension type fracture.

Introduction

The majority of children with distal radius fractures are caused by the stress transmitted from the palm to the wrist when children accidentally fell during activity. Most of the distal radius fractures can be fixed by only using manual reposition. Whereas as indicated by majority of scholars, some distal radius fractures with soft tissue incarceration and entrapment are still suggested to fix by surgical treatment, because manual reposition is more difficult and could increase damage to local tissues. Currently these fractures are treated mainly by cross K-wire fixation with a posterior approach. We found that in our long-term clinical work, extension type fractures constitute the majority. The periosteum on the palmar side is usually destroyed, whereas the dorsal periosteum is often undamaged. So, for the extension type fractures, surgical treatments with a dorsal approach will damage the dorsal periosteum, resulting in a long recovery time. In this article, we will report 30 patients inflicted with complex distal radius extension type fracture and experienced a failed manual reposition. They were treated by palmer approach with cross K-wire fixation between May 2014 and December 2017.

Methods

Patients

Thirty patients were recruited including 21 male and 9 female, with an average age of 8.5 years ranging from 5 to 13 years. No open

* Corresponding author.
E-mail address: liuchuankang@126.com (C.-K. Liu).

Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

https://doi.org/10.1016/j.cjtee.2018.08.003

injury was found in all the cases. The time between injury and treatment ranged from 1 to 30 days. Among these patients, 11 were right-sided fractures and 19 were left-sided ones. All patients were extension type fractures and received unsatisfied manual repositions prior to receiving the surgical operation.

Surgical management

Brachial plexus block anesthesia was conducted in these patients. Routine disinfection and tourniquet were employed on the upper arm. A longitudinal incision (approximately 3.5–4 cm) on the forearm radius was taken. The skin and subcutaneous tissue were separated. The blunt separation was made along the gap between the tendon of the brachioradialis and the flexor carpi radius. Also, a blunt separation was made along the extension of the broken pronator quadratus. Consequently, the fracture line was exposed. Next, aspirators and curette were used to remove hematomas, followed by an appropriate traction to remove the compressed tissue between the fracture lines. After a satisfactory reposition, a diameter of 1.4–1.8 mm K-wire was inserted on the radial side of the wrist from the distal styloid radius. This K-wire passed through the fracture line and the proximal radial cortex. Likewise, a second same K-wire was inserted at the same horizontal plane, but this K-wire passed through the fracture line and the distal radial cortex. Then, check the condition of the fracture reposition, and observe whether there was compressed tissue along the fracture line. Adjust immediately if the condition is not satisfied. Meanwhile, check the condition of ulnar fracture reduction, even though in most cases ulnar fracture was already reduced. Next, bend the tail of the K-wire needle, cut the rest of the needle until about 1 cm to the skin. Suture subcutaneous and skin, and apply sterile dressings. Use plaster for external fixation. If enough callus was observed during 3–6 weeks after surgery, it was time to pull out the needle, and meanwhile, do functional exercise. Finally, patients were asked to take periodic outpatient follow-up at 2, 3, 6, 12 months after surgery, and then, they were requested to take one outpatient follow-up every 12 months.

Efficacy evaluation

To evaluate the efficacy of surgical procedure, we used the Gartland and Werley score for assessing wrist function. Depending on the scores, the outcome is classified as excellent, good or poor.

Results

Thirty patients were evaluated after an average of 18 months (ranging from 5 to 36 months) after surgery. The recovery time of incisions was from 4 to 8 weeks (all incisions were primary healing), with an average of 6 weeks. No case of nonunion or delayed union was found. Based on the Gartland and Werley wrist score for assessing wrist function three months after operation, 24 patients were classified as excellent scores, 3 good scores, 3 acceptable scores, and no poor scores. Moreover, no adverse effects such as broken needle, infection, or wrist varus/valgus deformity were observed (Fig. 1).

Fig. 1. Front/lateral X-ray views of the left-sided distal radius extension type fracture (significant fracture displacement) of a six-year-old female patient who was treated in our hospital 2 days after injury (A and B); front/lateral X-ray views on the second day after surgery (C and D); front/lateral X-ray views of K-wire that had been pulled out (E and F).

Discussion

Concerning the children who did not have angulation rotation and displacement fractures of the distal radius, the fractures could be fixed with plaster cast.[1] However, for those who had significantly angulation rotation and displacement fractures of the distal radius, the fractures were mostly fixed by manual repositions combined with plaster for external fixation, or by closed reduction and percutaneous K-wire for internal fixation combined with plaster for external fixation.[2–4] Even though some cases suffering from fracture malunion to a certain extent, the distal radius fractures in children could be gradually remodeled.[5,6] For patients with irreducible distal radius fractures following a failed manual reposition, traction and reposition may not reach to a good level and may even lead to severe damage to soft tissues and nerve incarceration. These may be due to the reason that irregular fragments inserted into the muscles, tendons or nerves.[7] Manual reduction often requires to be repeated several times, which may induce more complications such as epiphyseal injury. Therefore, such fractures should be treated by open reduction and internal fixation.[8]

With regard to the choice between palmar and dorsal surgical approaches, there are no standard guidelines. Palmar approach has become more and more popular in adults,[9–11] because it is more beneficial for wrist function recovery than the dorsal approach.[12] For children, the majority of distal radius fractures are caused by falling on their palms with forearm in pronation and wrist in extension position and result in forward-angulated fractures and extension-type fractures. The front approach will not damage the dorsal periosteum, which is beneficial for manual reduction and fracture fixation. For old fractures of the distal radius, early surgery is still needed to prevent malunion or nonunion. The palmar approach is more conductive to callus removal.

For children with distal radius extension type fracture such as the lateral-forwarded displacements, damaged muscles and

tendons, and soft tissues in the volar part, a lateral approach is more conducive to the repair of muscles and tendons after fracture reduction and K-wire fixation. At the same time, this approach could protect the dorsal periosteum and soft tissues from being damaged, and thereby significantly reduced the surgical trauma. Thus, the front surgical approach for treating distal radius fractures in children could results in only little tissue damage.

Epiphyseal injury in the distal radius fracture in children is not rare. Remarkably, inappropriate treatment of fracture reduction and wrist valgus deformity will have a significant effect on the quality of children's life and their mental health.[13] K-wire fixation has little damage to the epiphysis because of its thin and smooth-surface needle. Among all the 30 cases in this series, 6 of the distal radius epiphyseal fractures were treated with front approach and K-wire fixation. No case of epiphyseal closure or wrist joint deformity was found during the follow-up period.

Regarding to the ways of K-wire fixation, many scholars choose to insert the K-wire from the dorsal wrist. In this way, the two crossed K-wire needles can fix the fractures firmly when the long axis of needle and the axis of forearm have the same direction. However, this kind of fixation requires wrist flexion in children. This long-term K-wire fixation and plaster for external fixation may lead to functional disorder of the wrist joint. In addition, this kind of fixation may cause wrist and tendon injury. In contrast, inserting the K-wire from radial radius can lead to less damage, which is conducive to postoperative recovery (two K-wire needles are inserted as mentioned above). In line with earlier research by Chinnusamy et al.,[14] a satisfactory result can be achieved by K-wire via a wrist-lateral approach for the treatment of distal forearm fractures.

Periosteal injury may also cause nonunion of pediatric forearm fractures.[15] Therefore, during the surgical process, maintaining the periosteum as much as possible is of great significance in the fracture reduction. The recovery time for front approach treatment in children is generally from 4 to 8 weeks (an average of 6 weeks). An early fracture healing is conductive to functional recovery of the fractures. Thereby, the front surgical approach for treating distal radius fractures in children contributes to rapid postoperative recovery.

The palmar approach via a front longitudinal incision with K-wire fixation in the treatment of children's distal radius extension type fracture has following advantages: (1) easy to reposition for both fresh and old fractures; (2) less soft tissue damage; (3) less soft epiphyseal injury; (4) quick recovery. It is suitable to treat children with distal radius extension type fractures.

References

1. Adrian M, Wachtlin D, Kronfeld K, et al. A comparison of intervention and conservative treatment for angulated fractures of the distal forearm in children (AFIC): study protocol for a randomized controlled trial. *Trials*. 2015;16:437. https://doi.org/10.1186/s13063-015-0912-x.
2. Huang W, Zhang X, Zhu H, et al. A percutaneous reduction technique for irreducible and difficult variant of paediatric distal radius and ulna fractures. *Injury*. 2016;47:1229–1235. https://doi.org/10.1016/j.injury.2016.02.011.
3. Kurien T, Price KR, Pearson RG, et al. Manipulation and reduction of paediatric fractures of the distal radius and forearm using intranasal diamorphine and 50% oxygen and nitrous oxide in the emergency department: a 2.5-year study. *Bone Joint Lett J*. 2016;98-B:131–136. https://doi.org/10.1302/0301-620X.98B1.36118.
4. Xu P, Dong XJ, Lu ZT, et al. Roof folding and rotary pushing for the treatment of back to back fractures of distal radius and ulna in children. *Zhong Guo Gu Shang*. 2015;28:864–867.
5. van der Sluijs JA, Bron JL. Malunion of the distal radius in children: accurate prediction of the expected remodeling. *J Child Orthop*. 2016;10:235–240. https://doi.org/10.1007/s11832-016-0741-9.
6. Manoli 2nd A. Irreducible fracture-separation of the distal radial epiphysis. Report of a case. *J Bone Joint Surg Am*. 1982;64:1095–1096.
7. Karlsson J, Appelqvist R. Irreducible fracture of the wrist in a child. Entrapment of the extensor tendons. *Acta Orthop Scand*. 1987;58:280–281.
8. Young TB. Irreducible displacement of the distal radial epiphysis complicating a fracture of the lower radius and ulna. *Injury*. 1984;16:166–168.
9. O'Shaughnessy MA, Shin AY, Kakar S. Stabilization of volar ulnar rim fractures of the distal radius: current techniques and review of the literature. *J Wrist Surg*. 2016;5:113–119. https://doi.org/10.1055/s-0036-1579549.
10. Naito K, Zemirline A, Sugiyama Y, et al. Possibility of fixation of a distal radius fracture with a volar locking plate through a 10 mm approach. *Tech Hand Up Extrem Surg*. 2016;20:71–76. https://doi.org/10.1097/BTH.0000000000000118.
11. Zhang P, Jia B, Chen XK, et al. Effects of surgical and nonoperative treatment on wrist function of patients with distal radius fracture. *Chin J Traumatol*. 2018;21:30–33. https://doi.org/10.1016/j.cjtee.2017.11.004.
12. Li YC, Zhang W, Liu SZ, et al. Comparison between volar and radial column approach by plate fixation for the treatment of unstable fracture of distal radius: a meta-analysis. *Zhong Guo Gu Shang*. 2016;29:21–26.
13. Larsen MC, Bohm KC, Rizkala AR, et al. Outcomes of nonoperative treatment of Salter-Harris II distal radius fractures: a systematic review. *Hand (N Y)*. 2016;11:29–35. https://doi.org/10.1177/1558944715614861.
14. Chinnusamy R, Redfern D. Antegrade cross K-wire in distal radius fractures: an alternative technique. *Tech Orthop*. 2016;31:61.
15. Song KS, Lee SW, Bae KC, et al. Primary nonunion of the distal radius fractures in healthy children. *J Pediatr Orthop B*. 2016;25:165–169. https://doi.org/10.1097/BPB.0000000000000257.