Original Article

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

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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.

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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 hema-
tomas, 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 reduct-
ion, 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 operation, 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).

**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. 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. Even though some cases suffering from fracture malunion to a certain extent, the distal radius fractures in children could be gradually remodeled. For patients with irre-
ducible 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. Manual reduction often requires to be repeated several times, which may induce more complications such as epiphysial injury. Therefore, such fractures should be treated by open reduction and internal fixation.

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 because it is more beneficial for wrist function recovery than the dorsal approach. 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. 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., 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. 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. Therefore, 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.

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