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Clinical application of multi-direction temporary Kapandji technique and volar locking plate fixation for type C distal radius fractures

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Abstract

Purpose Achieving and maintaining an optimal reduction in partially or fully displaced intra-articular fractures, specifically Type C distal radius fractures, can present challenges. This study aims to retrospectively evaluate and summarize a method utilizing multi-directional temporary Kapandji technique in combination with the volar locking plate fixation for these fractures.

Method The study involved 15 patients diagnosed with Type C distal radius fractures who underwent surgery between January 2024 and April 2024. The procedure incorporated a multi-directional temporary Kapandji technique, followed by stable osteosynthesis using a volar locking plate system. The functional outcomes were assessed after 4 (2–6) months of follow-up using the modified Mayo wrist scoring system (MMWS). The MMWS is a rating system used to evaluate wrist function and pain, including pain, motion, grip strength.

Results All the patients incision healed within 2 weeks. All the fractures had uneventful union within 8–12 weeks. Based on the modified Mayo wrist scoring (MMWS) system, most patients showed good to excellent functional recovery.

Conclusion This reduction method proved to be both simple and replicable, enabling satisfactory alignment with minimal force. The volar locking plate system provided rigid and stable fixation.

Keywords Multi-direction temporary Kapandji technique, Volar locking plate fixation, Type C distal radius fractures

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Introduction

Distal radius fractures are frequently encountered in the clinical settings, with 41-50% affecting the articular surfaces of the distal radius [1]. While CT scanning offers a superior means of fracture evaluation, both conservative and surgical treatments are available. Recent advances in the implants and surgical methods have made surgery a more viable option, often yielding improved outcomes. The volar locking plate is increasingly favored due to its straightforward approach and the associated high rate of functional recovery [2–5]. Achieving proper fracture reduction is crucial when using the volar plate for osteosynthesis in dorsally and radially displaced Type C fractures [6–9]. Kapandji introduced a technique that employs the Kirschner wires (K-wires) to lever the displaced fragment of a distal radius fracture into alignment [10]. This method, which facilitates both reduction and fixation, is particularly useful for treating irreducible, comminuted fractures. By applying volar-directed force with the Kapandji technique, dorsally displaced fragments can be effectively reduced, especially to restore anatomic volar tilt. We propose a multi-directional temporary Kapandji technique combined with volar locking plate fixation to aid in the reduction of Type C distal radius fractures, positioning the bone centrally with the K-wires and plate on either side. This study aims to summarize a method utilizing multi-directional temporary Kapandji technique in combination with the volar locking plate fixation for these fractures.

Patients and methods

Fifteen patients with Type C distal radius fractures were treated surgically between January and April 2024. The mean age of the patients was 57 years (range 45–70), 5 men and 10 women. The mechanism of injury was fall injury. The procedure incorporated the multi-directional temporary Kapandji technique, followed by stable osteosynthesis using a locking plate system. Initial management involved manual fracture reduction and plaster external fixation to alleviate pain. Surgical intervention was performed within 5–7 days post-injury. All fractures were classified using the AO system and evaluated through standard wrist radiographs and CT scans. Informed consent was obtained from each patient.

Surgical techniques

Approach

The volar Henry approach, which lies between the radial artery and the flexor carpi radialis tendon, was used for most fractures. A longitudinal skin incision aligned with the flexor carpi radialis tendon was made, and the fracture site was exposed by subperiosteal elevation of the pronator quadratus.

Multi-direction temporary Kapandji technique

Fracture reduction was initiated with traction and counter-traction, followed by marking the insertion points for the K-wires. Temporary stabilization was achieved using 1.5-mm K-wires. The first K-wire was inserted percutaneously along the lateral margin of the radius, reducing the radial styloid fragment and restoring the distal radial height (Fig. 1a). The second K-wire was placed at the apex of the radial styloid and passed through the opposite cortical bone to secure the radial styloid (Fig. 1b). Two additional K-wires were introduced dorsally to restore volar tilt by leveraging the dorsal cortex; once corrected, the K-wire was advanced to the volar cortex (Fig. 1c-d). An additional K-wire was used to stabilize the ulnar fragment (Fig. 1e). In some cases, more than two K-wires were applied. Fluoroscopic imaging confirmed correct K-wire placement and successful fracture reduction.

Volar locking plate fixation

The volar locking plate was positioned in the appropriate location, and temporary stabilization was achieved using 1.0-mm K-wires to hold the plate onto the bone. Initially, a cortical screw was inserted into the oblong hole to secure the plate. Once the cortical screw was tightened, the plate was adjusted to the correct level, verified using lateral fluoroscopic views. Locking screws were then inserted to provide firm fixation of the fragments.

Functional evaluation criteria

The clinical outcomes were evaluated using the modified Mayo wrist scoring (MMWS) system including pain, motion, grip strength. The ability to return to regular employment or activities after 2 weeks [11]. Good to excellent outcomes could be achieved in most cases. An excellent result was defined as 90 to 100 points, good was 80 to 89, fair was 65 to 79 points, and poor was <65 points.

Results

All the patients were reviewed. No major medical complications, no infection, delayed union, or nonunion, no further fracture displacement or extensor tendon ruptures was recorded. All the patients incision healed within 2 weeks. All the fractures had uneventful union within 8–12 weeks. The functional outcomes were assessed average follow-up of 4 (2–6) months. According to the MMWS system, the functional assessment revealed good to excellent results in most cases (Table 1).

Cases presentations

Case 1

A 64-year-old female presented with left wrist pain and swelling because of falling. A thorough examination revealed a distal radius fracture. After the fracture of the

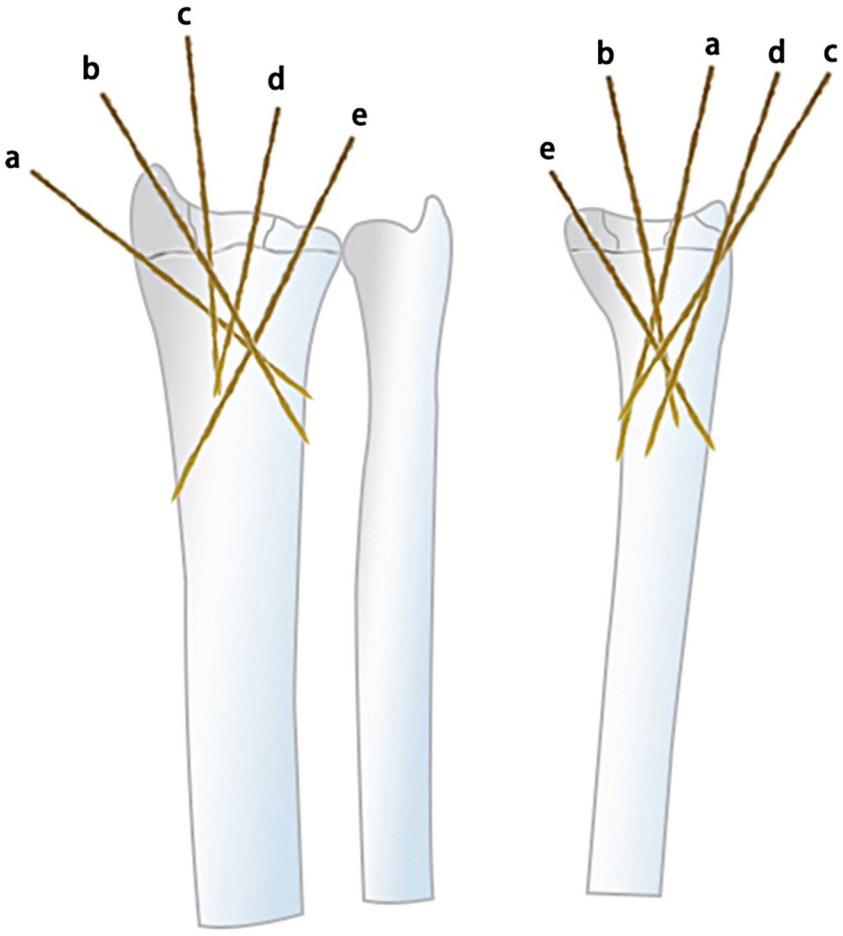

Fig. 1 The reduction of the fracture was performed and maintained using the multi-direction temporary Kapandji pinning technique

Table 1 Clinical outcomes by Modified Mayo Wrist Score (MMWS)

Modified Mayo Wrist Score	Number	Percentage (95% CI)
Fair (65-79)	1	6.67 (0, 19.40)
Good (80-89)	3	20.00 (0, 40.24)
Excellent (90-100)	11	73.33 (50.95, 95.65)

MMWS: Modified Mayo Wrist Score CI: Indicates confidence interval

patient, the first is manual reduction, and then plaster external fixation to reduce the pain. Giving cold compress, other treatments were relieving swelling and pain. Preoperative wrist CT examination was performed to evaluate the fracture (Fig. 2a). The reduction of the fracture was performed using the multi-direction temporary Kapandji technique, and the volar locking plate can be placed in the appropriate position (Fig. 2b-c). Wrist CT was reviewed again after surgery to evaluate fracture reduction and the position of plates and screw (Fig. 2d).

Case 2

A 56-year-old male was hospitalized with distal radius fracture (Fig. 3a). Preoperative wrist CT examination was performed to evaluate the fracture (Fig. 3b). The reduction of the fracture was performed using the multi-direction temporary Kapandji technique, and the volar locking plate can be placed in the appropriate position (Fig. 3c). Wrist CT was reviewed again after surgery to evaluate fracture reduction and the position of plates and screw (Fig. 3d).

Discussion

There are multiple treatment options for the distal radius fractures, including open reduction with plate fixation, external fixators, and conservative approaches [3]. Achieving a proper reduction is crucial for ensuring good functional outcomes, and we support the view that better fracture reduction plays a pivotal role in predicting the overall functionality post-treatment [12].

In particular, open reduction combined with volar locking plate fixation has emerged as a leading approach, especially for treating Type C distal radius fractures [13]. Several studies have demonstrated positive results, particularly when temporary Kapandji is used alongside external fixation [12]. Kapandji originally described a

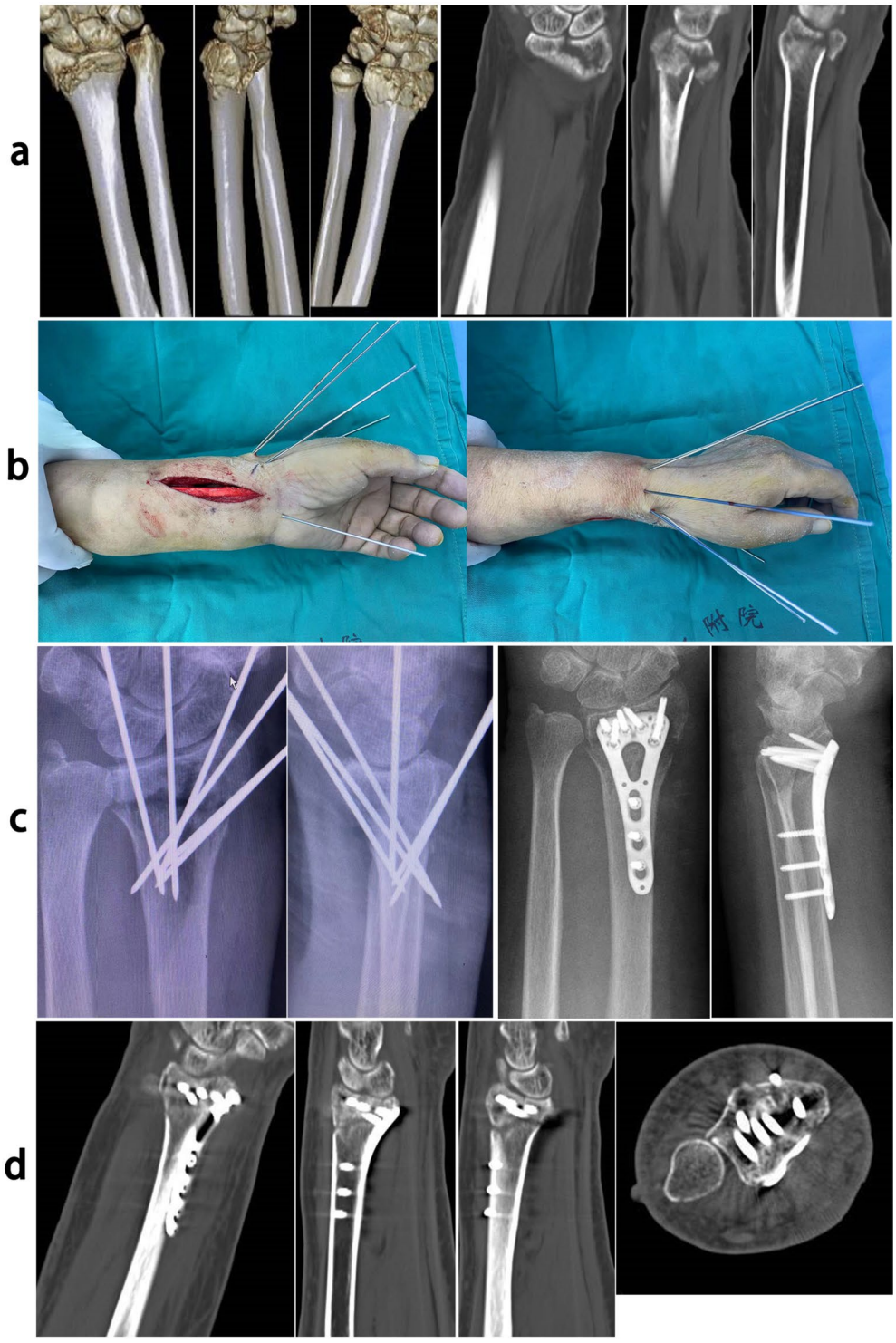

Fig. 2 **a**: preoperative wrist CT examination; **b**: image of multi-direction temporary Kapadndji pinned technique; **c**: radioraphy on wrist of multi-direction temporary Kapadndji pinning and volar locking plate; d: postoperative review wrist CT

method using K-wires to fix distal radius fractures [14, 15]. While K-wire fixation remains a widely used technique, it has faced criticism for its instability and the challenges in maintaining reduction [16–18].

In this study, we employed a combination of multi-directional temporary Kapandji and volar locking plate fixation to treat Type C distal radius fractures. Initially, Kapandji K-wires were utilized to reduce dorsally

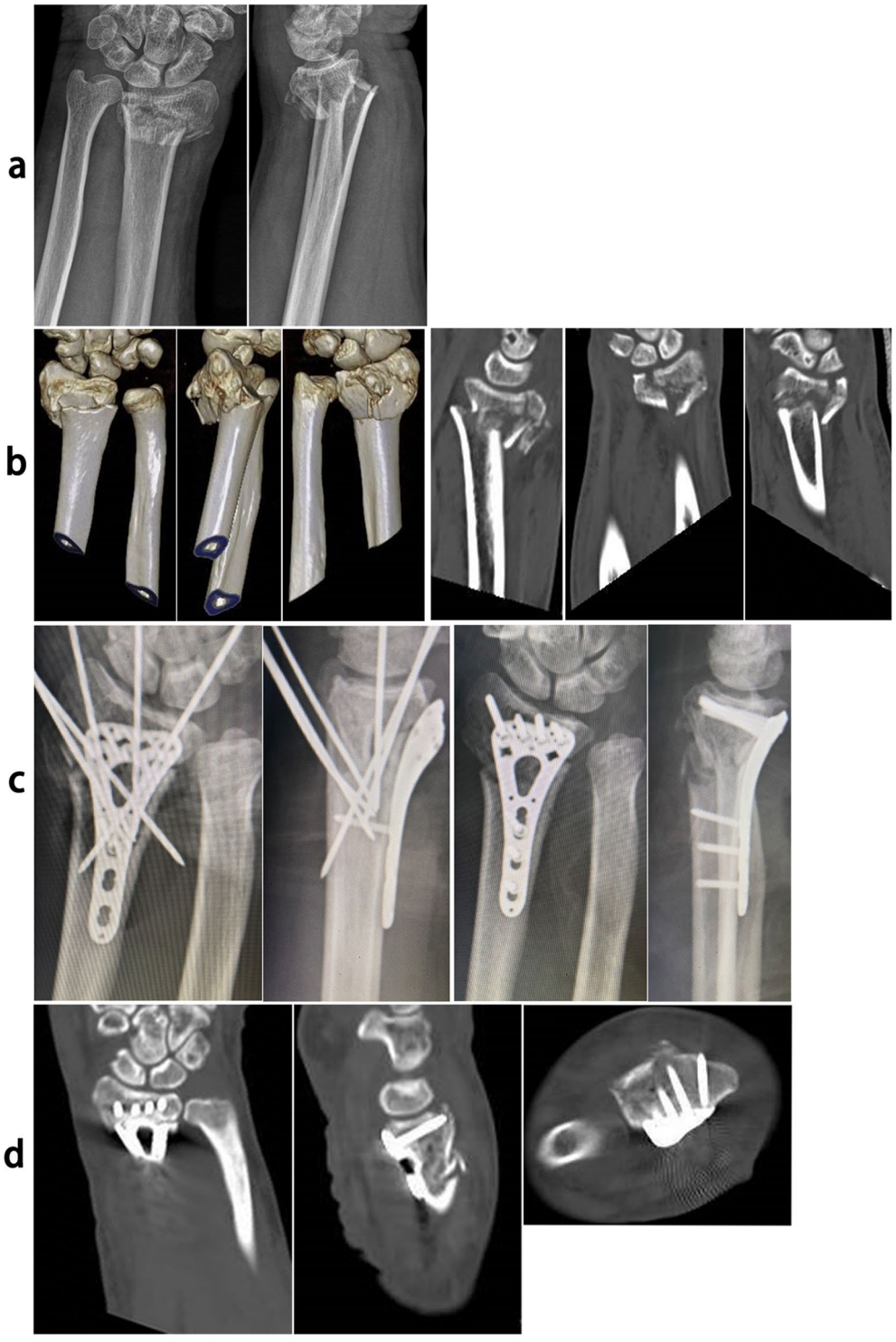

Fig. 3 **a**-**b**: preoperative wrist radiography and CT; **c**: multi-direction temporary Kapadndji pinning technique and volar locking plate; **d**: postoperative wrist CT

displaced fractures, applying volar-directed force to restore volar tilt. Next, bilateral Kapandji K-wires were inserted to reduce displaced fragments and apply ulnar-directed force, restoring radial height and inclination. Finally, an anatomical plate was used to buttress and reposition the distal fragment, completing the osteosynthesis.

Patient outcomes are largely determined by the quality of the reduction, including factors like radial height, radial inclination, ulnar variance, and volar/dorsal tilt [19]. However, based on our experiences, postoperative functional exercise is of greater importance. Once patients can tolerate incision pain, functional exercises begin under medical guidance, starting with finger flexion and extension and gradually progressing to wrist movement. The selection of the timing for rehabilitation is critical. Most researchers agree that initiating functional exercises earlier and minimizing prolonged postoperative joint immobilization can lead to better recovery of wrist joint function [20]. Therefore, we recommend starting finger functional exercises within 24 h after surgery and encouraging light functional activities using the injured limb [21]. This rehabilitation protocol helped avoid complications such as finger or wrist stiffness.

The advantages of the technique offer simplicity, reproducibility, and eliminates the need for dorsal exposure by only requiring a volar approach; no further fracture displacement was found after volar locking plate fixation. The patients were able to encourage the postoperative rehabilitation protocol. But our study possessed some limitations such as the follow-up time was short, small number of patients and was not compared with other techniques.

The multi-directional temporary Kapandji technique aids surgeons in achieving optimal reduction prior to placing the volar plate when treating displaced Type C distal radius fractures.

Conclusions

The use of multi-directional temporary Kapandji in combination with volar locking plate fixation for Type C distal radius fractures is both feasible and effective. It is a recommended approach for treating Type C distal radius fractures.

Abbreviations

MMWS	Modified mayo wrist score
CI	Indicates confidence interval

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Author contributions

Wei Zhao, Kun-xiu Song wrote the main manuscript text and Yong-tao Liu, Bing-dong Ma prepared Figs. 1, 2 and 3. All authors reviewed the manuscript.

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Data availability

The data presented in this study are available on request from the corresponding author.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Binzhou Medical University Hospital (KYLL-216) and conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was got from each included patient.

Informed consent

Informed consent was obtained from all participants for using their imaging data and questionnaire scores.

Consent for publication

Written informed consent to publish the clinical details and images of the patient was obtained.

Competing interests

The authors declare no competing interests.

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