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Outcomes of two-stage double-level rotational osteotomy in treating patients with congenital proximal radioulnar synostosis

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Congenital proximal radioulnar synostosis (CPRUS) is a rare anomaly which is caused by abnormal fusion of the proximal radius and ulna during development. This is due to the failure of embryological separation, resulting in the fixed position of the forearm, from mild to severe pronation.[1] Mild deformity leads to slight disability because the shoulder and wrist can effectively compensate.[2] Patients with bilateral cases and/or pronation deformity of >60° may be severely limited in daily activities.[3 4] Most surgeons recommend surgical intervention when the loss of forearm rotation exceeds 60°, particularly when the forearm is fixed in pronation.[5] Even when restoring a complete range of motion (ROM) is impossible, surgical management of congenital radioulnar synostosis enhances limb function.[5 6] Currently, the most common treatment for CPRUS is rotational osteotomy of the proximal ulna and distal radius, either single-stage rotational correction or two-stage rotational correction. The aim of this study was to analyze the clinical outcomes of two-stage rotational correction after osteotomy of the proximal ulna and distal radius in patients with CPRUS who had fixed pronation deformity.

We selected 17 children (26 forearms) with CPRUS who were consecutively treated in the Department of Orthopedics, the Children Hospital of Zhejiang University School of Medicine, and the Department of Orthopedics, Fujian Children Hospital from March 2013 to March 2021. Patients were diagnosed with CPRUS according to the complaints and signs of limited rotation of the forearm, as well as radiographic synostosis of the proximal ulna and radius (figure 1). All included patients received two-stage double-level derotational osteotomy of the proximal ulna and the distal radius and were then fixed with plaster casts.

The specific steps were as follows: Under general endotracheal anesthesia, the patient was positioned supine and a tourniquet was attached to the arm. Under radiographic surveillance, radial osteotomy was performed at the distal diaphyseal–metaphyseal junction, and ulna osteotomy was performed 1 cm distal to the level of synostosis (figure 2). The osteotomies were done by using an oscillating saw. After the osteotomies, the forearm was first rotated to half of the expected correction angle. For example, the preoperative forearm pronation deformity was 90°; the estimated postoperative forearm pronation deformity was 0°; and the first-stage rotation would be approximately 45°. The radius and ulna were not fixed with implants. The distal circulation was verified after releasing the tourniquet. The wounds were irrigated and closed with the fascia left open. An above-elbow plaster cast with 90° of bending at the elbow was applied to keep the forearm at the desired position (figure 3). The patient was readmitted to the hospital 1 week later. After general anesthesia, the patient was placed in the supine position and the plaster cast was removed. The forearm was finally rotated to the targeted position (neutral or 10°–20° pronation). It took 5 min to see if there was a neurovascular issue. If not, a plaster cast was placed above the elbow again, with the elbow 90° flexed. Patients were actively followed up to see if the corrected position of the forearms was lost. When union at the osteotomy site was confirmed radiographically, the cast was removed, generally at 4–6 weeks after the second stage of operation.

The difference between preoperative and postoperative forearm fixation pronations was of statistical significance (71.35°±16.16° vs 7.30°±8.27°, p<0.001). After 22 months of follow-up, bone healing was achieved with no loss of correction in all patients. All the children

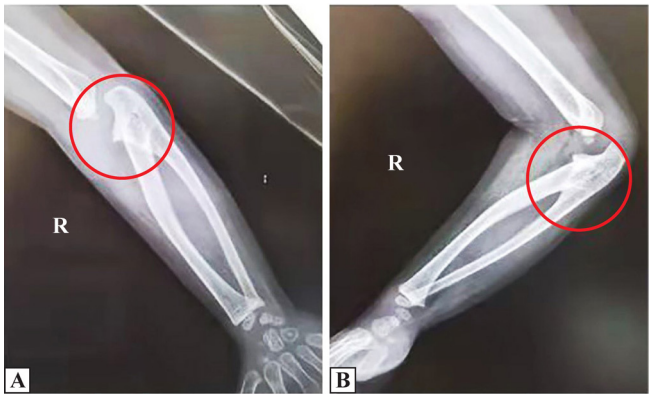

Figure 1 Preoperative anteroposterior (A) and lateral (B) radiographs of a patient with congenital proximal radioulnar synostosis.

had improved forearm function, no limitation of elbow and wrist functions, and no vascular or nerve complications.

The surgical techniques for the treatment of radioulnar synostosis can be divided into two groups: (1) surgery to improve the pronation position through synostosis resection, regardless of whether biological or synthetic materials are inserted; and (2) surgery to improve the fixation position of the forearm. Although restoration of forearm rotation and improvement of function seems to be the ideal treatment, attempts at synostosis resection and joint reconstruction have generally been unsatisfactory due to loss of correction,

Figure 2 Immediate postosteotomy imaging of a patient with congenital proximal radioulnar synostosis (severe pronation deformity).

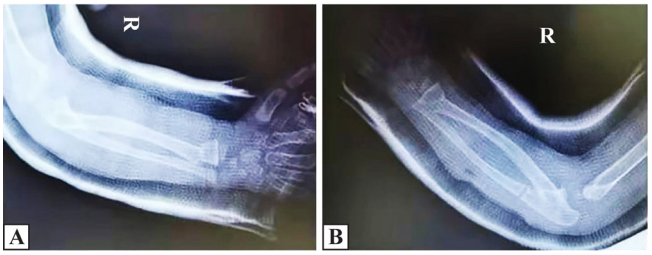

Figure 3 Anteroposterior (B) and lateral (A) radiographs after second-stage rotational correction and plaster fixing (the affected forearm was brought to neutral position).

recurrence of bony bridging, minimal motion, compartment syndrome, and vascular compromise following extensive soft-tissue release and derotation.[7] Synostosis resection alone has been demonstrated to be unsuccessful.[8]

Compared with two-stage rotational correction, single-stage rotational correction usually requires internal fixation and a second surgery to remove the implant.[9] One-step rotational correction with a wide angle may put the affected forearm at a higher risk of vascular or neurological complications.

In this study, two-stage double-level derotational osteotomy yielded a functional outcome comparable to or better than other surgical procedures that have been proposed. Our experience suggests that it is a viable option in selected patients with CPRUS, particularly active patients whose forearm is fixed in pronation.

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