CASE REPORT

Distal Forearm Replantation in a Child: A Case Report with a 30-year Follow-up

Lee S Hee[1], Kim Hyung-Sik[2], Lim Hong-Chul[3]

Abstract

Background: Amputation in the upper extremities influenced the quality of life a lot adversely. So, replantation was tried in many cases of amputation. Especially, due to good plasticity and healing capacity, replantation in children should be actively attempted. On the contrary, owing to growth potential in children, there are several late complications to happen like shortening and synostosis. There are only a few long-term follow-up reports of paediatric patients after replantation of upper extremities. We report a case of successful distal forearm replantation in a 2-year-old child who sustained a wringer injury by a sawing machine with a follow-up of 30 years.

Case description: A 2-year-old female patient was brought to our institution after a wringer injury to the distal forearm by a sawing machine. She sustained a near-total amputation at the distal forearm level with only a skin tag. Replantation was performed 4 hours after the injury. Radius and ulnar fractures were fixed with Kirschner and roll wires. The radial and ulnar arteries were anastomosed and three veins were anastomosed too. The median, ulnar, and radial nerves were managed by epi-perineurorrhaphy. The muscles were readapted, flexor tendons were performed tenorrhaphy each by each, and extensor tendons were performed grouping tenorrhaphy. Ten years after the replantation, a supination motion block was developed but successfully managed.

Conclusion: Replantation of upper limbs in children is an eceedingly worthwhile procedure. Though due to growth potential several complications were developed unlikely in adults. But those can be improved with additional procedures. Good plasticity and healing capacity of children make good functional outcomes in long-term follow-up. So, replantation of upper limbs in children should essentially be considered and aggressively performed.

Keywords: Case report, Distal forearm replantation, Replantation in children, Upper limb replantation.

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Background

Amputation in the upper extremities influenced patients' quality of life a lot adversely.[1] A disability cannot only cause decreased living independence but also constricted social relations and the ability to work.[2] So, replantation was tried in many cases of amputation in the upper extremities.

The prognosis of replantation is dependent on various factors; the most important thing is patient selection.[3] Relative indications contain amputations of the thumbs or multiple digits, amputations outside zone II, and amputations at any level in children.[3–6] Especially, because children have good plasticity and healing capacity, replantation should be actively attempted.[7] Replantation in children generally brings superior outcomes than those seen in adult patients.[7]

On the contrary, it is hard to satisfy parents' high expectations of surgery. And owing to the growth potential in children, there are several late complications to happen like shortening and synostosis in the cases of replantation in children.[8] So, a second operation is commonly needed to improve the remaining disability in the replanted limb.

Some papers have been published on the successful cases of paediatric patients' replantation. But there are a few long-term follow-up reports about paediatric patients after replantation. We report a case of successful distal forearm replantation in a 2-year-old child who sustained a wringer injury by a sawing machine with a follow-up of 30 years. After the replantation, early and late complications happened but these were successfully treated.

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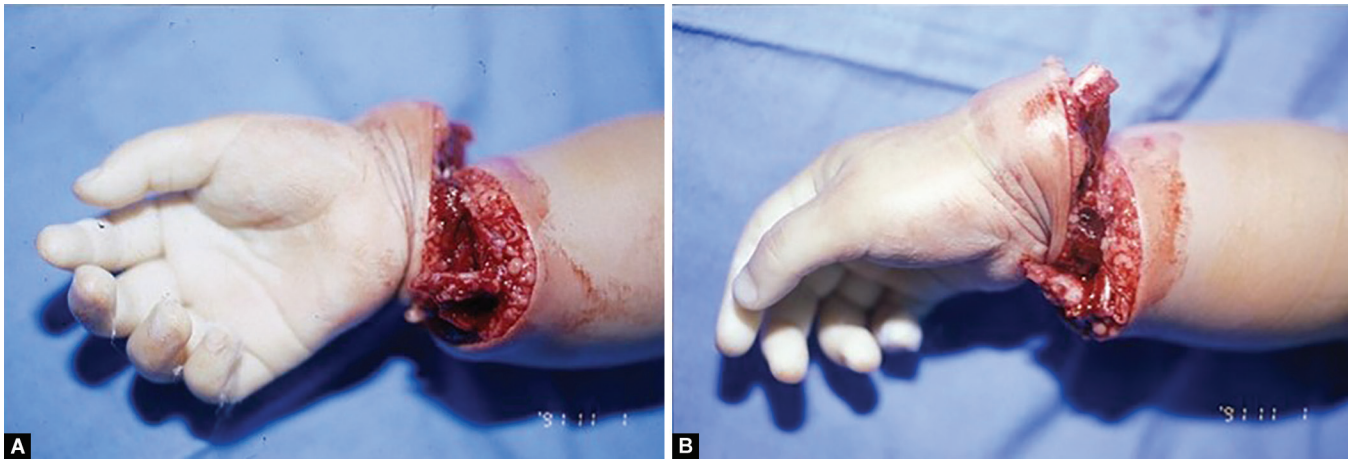
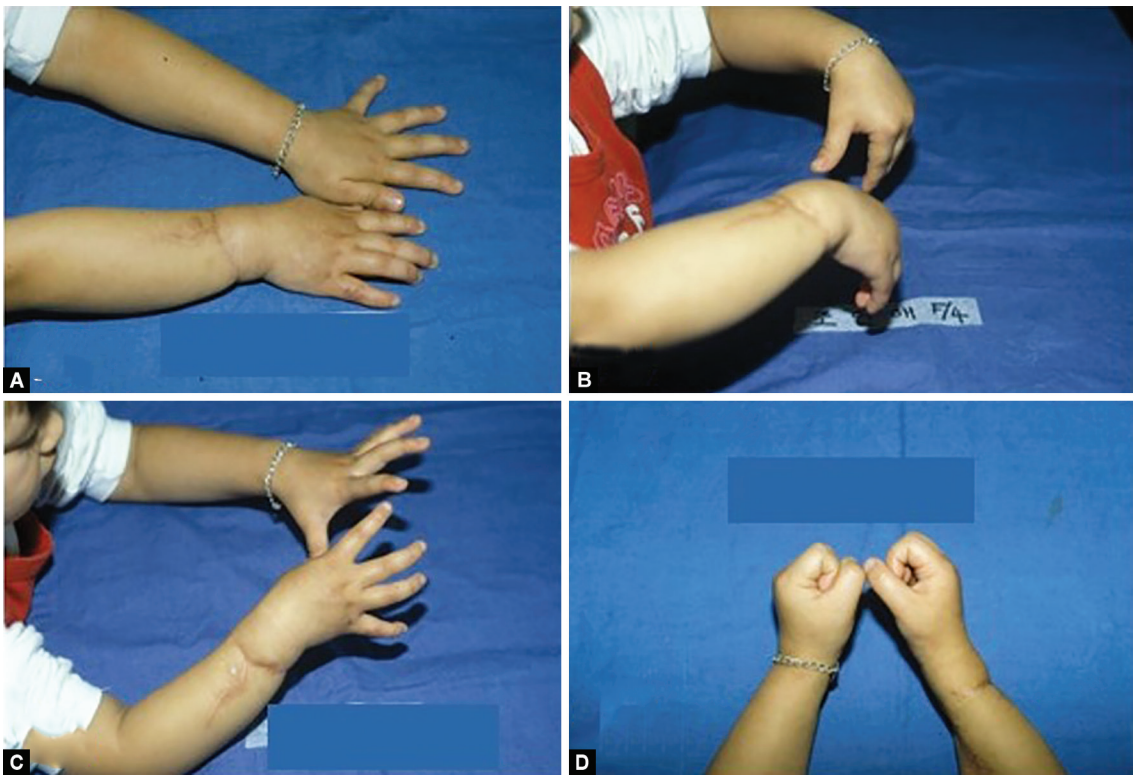
Case Description

A 2-year-old female patient was brought to our institution after a wringer injury to the distal forearm by a sawing machine. She sustained a near-total amputation at the distal forearm level with total disruption of the tendons, muscles, vessels, and nerves, as well as a fracture of both forearm bones at the distal one-third level. Just a 2-cm-sized skin tag was connected to the stump (Fig. 1). There were no other injuries.

Replantation started 4 hours after the injury. Preparation of the stump and the amputated forearm was performed. After massive debridement, identification of the vascular, nervous, and muscular structures was performed. The radius and ulnar fractures were fixed with Kirschner and roll wires. Radial and ulnar



Figs 1A and B: Near total forearm amputation state of a 2-year-old girl who had wringer injury by sawing machine



Figs 2A to D: (A) Replanted limb at 2 years follow-up; (B) Wrist extension; (C) Wrist flexion; (D) Clench

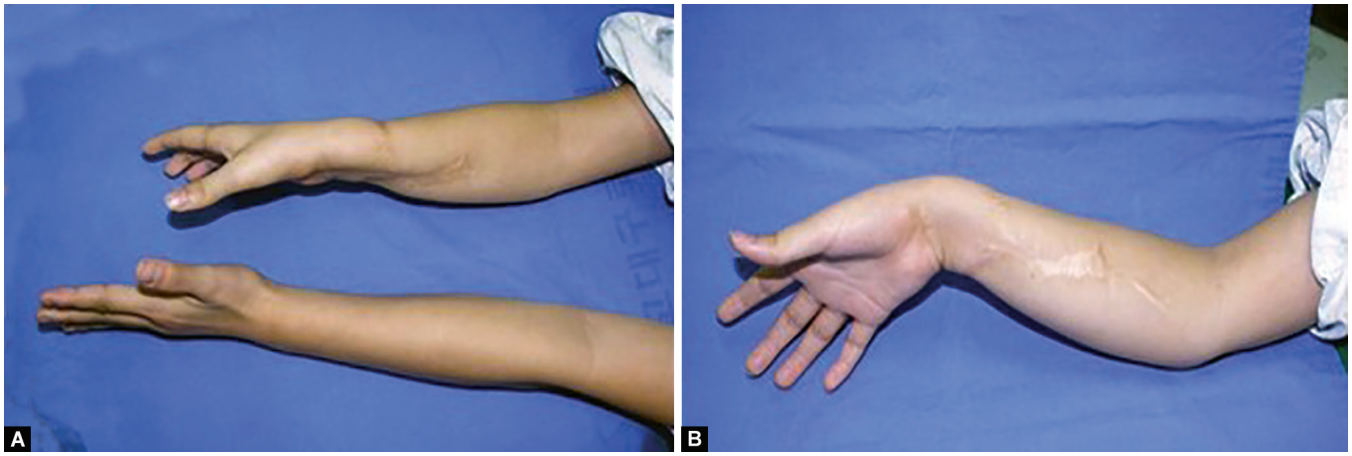
arteries were anastomosed and three veins were anastomosed too. The median, ulnar, and radial nerves were managed by epi-perineurorrhaphy. Muscles were readapted, flexor tendons were performed tenorrhaphy each by each, and extensor tendons were performed grouping tenorrhaphy.

Post-operatively, the patient tolerated the procedure well. Post-operative recovery was excellent and rehabilitation therapy was initiated.

At 2 years after replantation, motor and sensory functions were successfully recovered. She displayed wrist extension which was mildly reduced (Fig. 2).

Ten years after the injury, she had gradual difficulty with wrist supination and shortening at the replanted limb (Fig. 3). On the follow-up X-ray, the previous fracture site was healing but synostosis between the radius and ulna was found at the amputated level (Fig. 4). Wrist supination motion was important for competent hand movements.[9] So, she underwent surgery for ulnar shaft osteotomy for pseudoarthrosis-like Sauve–Kapandji procedure (Fig. 5). Three months after the surgery, she recovered wrist supination at 80°, and social function like holding a pencil had much improved (Fig. 6).

The last follow-up was 30 years after the replantation, and she showed an excellent range of motion and sensibility in two-point



Figs 3A and B: Replanted limb at 10 years follow-up. Difficulty on wrist supination and shortening at replanted limb

Figs 4A and B: Radiography showing previous fracture site was healing but synostosis between radius and ulnar was found at amputated level

discrimination, pain, and temperature (Fig. 7). She has no trouble with her daily living and is satisfied with the outcome.

Discussion

Replantation of upper extremities was first reported in 1962 by Malt. Since then, dramatic advances have been made.[10] The latest results showed that replantation is operated on in about 15% of upper extremity amputated cases, with the rate of success reaching about 80–90%.[1,2,11] Commonly, replantation in paediatrics often brings superior functional results compared to adult population. Paediatric patients have better healing potential with excellent nerve recovery capacity.

According to Kim et al., paediatric replantation success rates were reported from 63–97%.[7] Favourable prognostic factors for replantation in children under 34 months of age include clean lacerations and body weight greater than 11 kg.[12] Saies et al. reported 120 cases of upper extremity paediatric replantation. It reported that the success rate was 72% when the amputation had resulted from a laceration injury and 53% when the amputation had resulted from a crush or an avulsion injury.[13]

Seeing the situation from a different angle, in replantation of paediatric patients, late complications like shortening and synostosis due to growth and healing potential happened. So, when treating children, it should be considered.[7]

The goals of upper extremity major replantation are the preservation of function, independence, and prevention of chronic pain. Admittedly, the replanted part may not have the same function as the contralateral limb, but by providing a sensate extremity that can be utilised as a helper's hand.[14] The long-term subjective functionality of replanted upper extremities is satisfactory for patients, and patients appear to have adapted to impaired function, even if their functionality is reduced.[2] The patient in our case showed a shortening of the affected limb. But she regained almost normal levels of functionality and she was very satisfied with her replanted upper limb too.

Conclusion

Replantation of upper limbs in children is an exceedingly worthwhile procedure. Though due to growth potential, several complications were developed unlikely in adults. But those can be improved with additional procedures. And good plasticity and healing capacity of children make good functional outcomes in long-term follow-up. So, replantation of upper limbs in children should essentially be considered and aggressively performed.

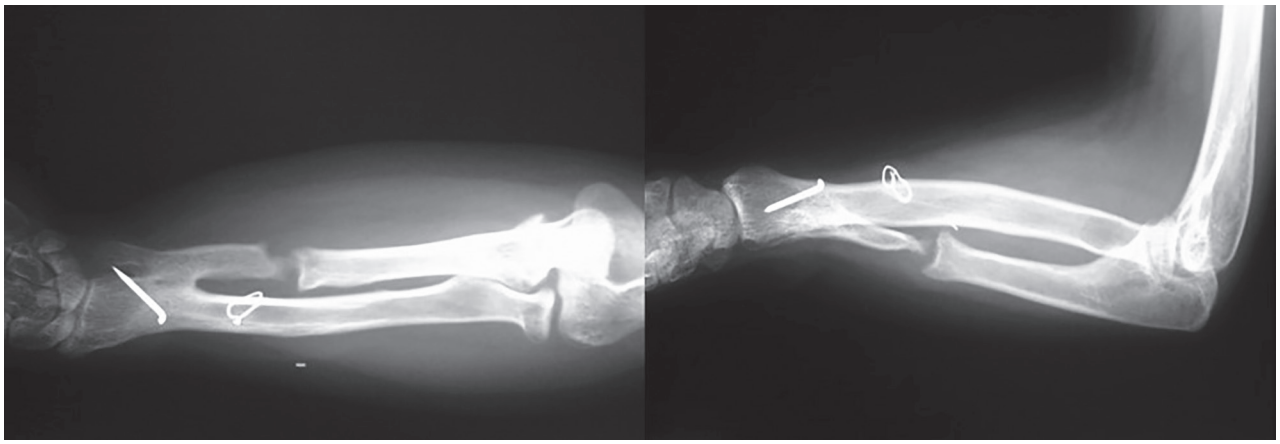
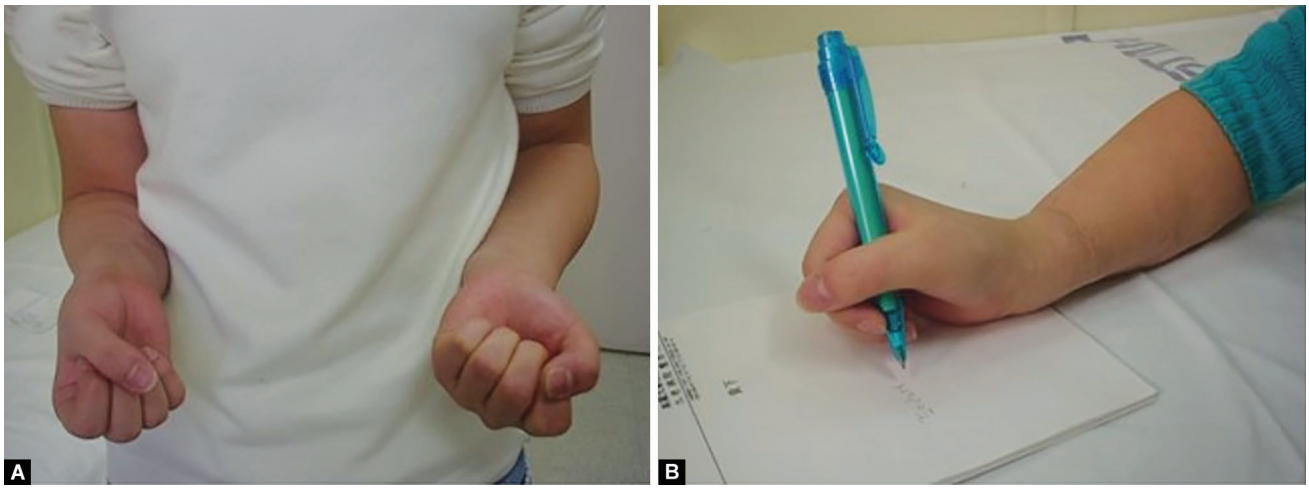
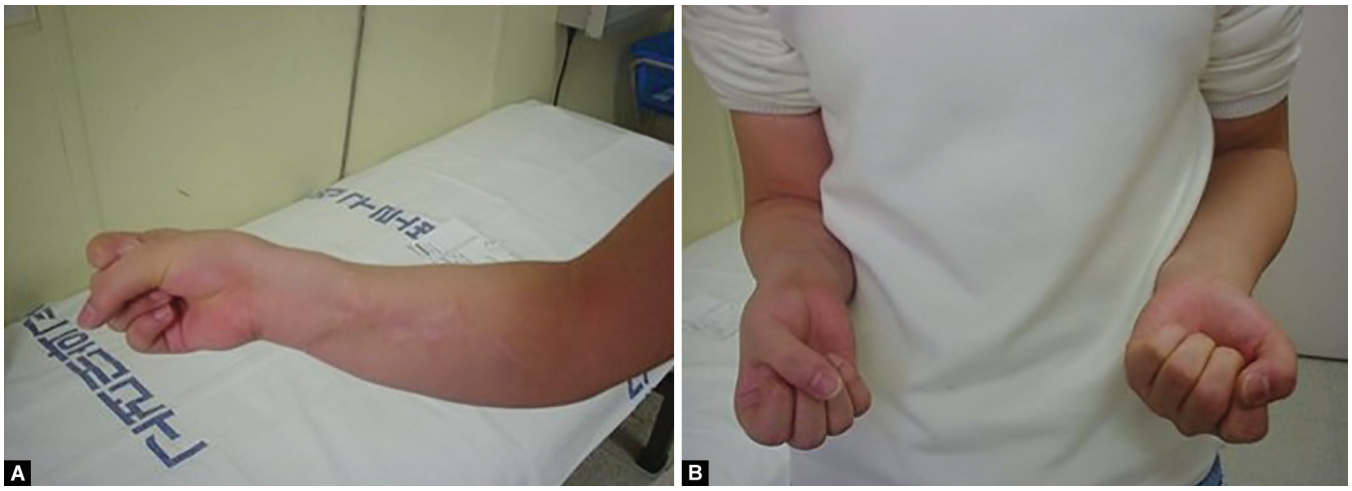


Fig. 5: Post-operative radiography



Figs 6A and B: (A) 3 months after surgery, wrist supination 80°; (B) Social function like holding pencil was much improved



Figs 7A and B: Replanted limb at 30 years follow-up

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