

Replantation at the level of the wrist joint: A case report

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ARTICLE INFO

Article history:

Received 24 July 2019

Accepted 9 August 2019

Available online 13 August 2019

Keywords:

Wrist amputation
Hand amputation
Motor function
Sensory function
Rehabilitation

ABSTRACT

Upper extremities amputations are devastating injuries that have a major impact on patients' quality of life. Replantation after traumatic amputation is often performed to obtain limb recovery. Following the high survival rate of replantation of post-traumatic hand amputation, recent emphasis has now shifted to functional recovery rather than survival only. Wrist replantation remains a challenging procedure for orthopaedic and hand surgeon. We reported a case of a 25-year-old male with traumatic amputation of the right hand.

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1. Introduction

The hand plays an important role in daily activities, including in work. Although hand amputation is not a life-threatening event, it causes tremendous functional impairment and decreased quality of life, which may cause conflicts regarding work, hope and quality of life.^{1–5} Successful replantation following complete wrist amputation is undoubtedly worthwhile as it has great a great potential for functional recovery.⁶ Arm replantation firstly succeeded in 1962, and hand replantation followed soon in 1964. Since then, hand replantation has become an established and standard procedure.^{7,8} This procedure aims to restore function and appearance, regain sufficient sensation for the performance of normal daily tasks and allow patients going back to their previous employment.^{9–13}

Despite advances in hand replantations, reports regarding the outcome of wrist replantations are uncommon.¹⁴ We reported a 25-year-old male with traumatic amputation treated with wrist replantation.

1.1. Case report

A 25-year-old male presented with pain on the right hand since 7 hours before admission. Initially, his right arm was struck by an unknown person using a machete. The patient was directly referred

to our institution. The amputated hand was then searched by the family at the crime scene and brought to the hospital 1 hour after. The right hand was kept in moist dressing with a plastic bag. No abnormality and complain of other parts of the body. No history of past illness, asthma, or fracture.

Physical examination demonstrated amputated laceration at the level of the right wrist as well as active bleeding (Fig. 1). Pain (visual analogue scale of 3–4) and tenderness on palpation. There was no restriction of the range of movement of the elbow.

The patient was resuscitated, and during further assessment, plain radiography was performed, showing amputation of both distal third of the right radius and ulna involving carpal bones. The patient was diagnosed with traumatic amputation of the right hand and underwent replantation and stump repair in the emergency operating room (Fig. 2)

Preoperatively, the patient was administered with analgesics and anti-stress ulcer medication. While the patient was being prepared for surgery, the amputated part is debrided and cleansed. Vessels and nerves were identified (Fig. 3A & B). Locking sutures were placed in tendons and bone was prepared for fixation. The procedure used x3.5 loupe magnification lense. The bones were shortened about 1.5 cm. The patient was sedated with general anaesthesia, and appropriate vascular access and monitoring had been established, the injured extremity was isolated in the operating field.

The stump was prepared by 1-cm shortening of both bones, debridement of distal tissues, and identification of the arteries, veins, and nerves. A 3 mm Kirschner wire was passed through both radius and ulna. Radial and ulnar arteries as well as the cephalic

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Fig. 1. Clinical presentation of forearm stump. The amputated right hand was resulted from sharp laceration.



Fig. 2. Amputated hand.

vein were successfully repaired followed by nerve repair. The tendons were individually repaired, or mass repaired expeditiously to avoid delay. Finally, skin closure was achieved (Fig. 4A & B).

The patient was administered with a single dose of low molecular weight heparin intraoperatively, aspirin for two weeks and broad-spectrum antibiotics for seven days. No complications occurred during the operative procedure (Fig. 5). All wounds healed, and the patient was discharged after three weeks. After four weeks post-operatively, the patient started to perform physiotherapy.

We found that the patient showed progressive improvement in motor and sensory functions during six months of follow-up (Fig. 6). He started to exhibit flexion and extension movements at the wrist, metacarpophalangeal and interphalangeal joints and signs of initial sensory recovery. However, he sometimes felt pain around the wrist. There was some slight movement in his fingers, but still, it could not be used functionally in daily. The patient was

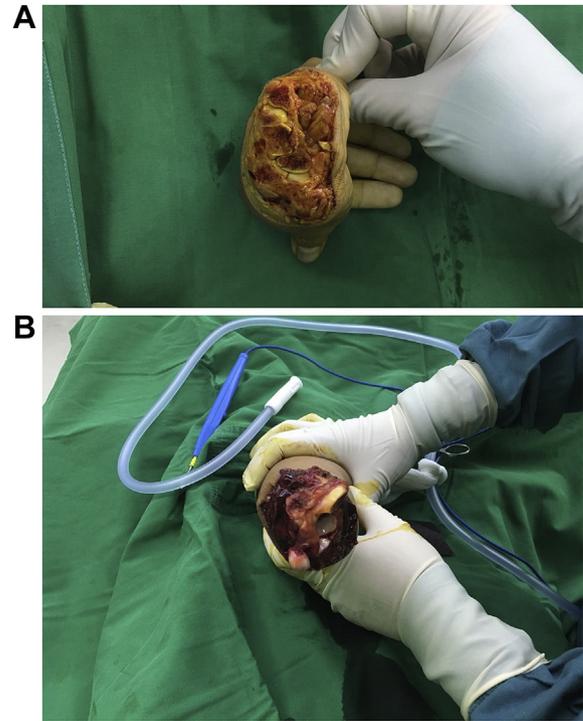


Fig. 3. Debridement and identification of vessels and nerves on the A. Amputated hand, B. forearm stump.

planned to perform K-wire removal and then perform wrist arthrodesis using plate and screw.

Preoperatively, the patient was administered with analgesics and anti-stress ulcer medication. The approach for wrist arthrodesis is dorsally between the third and fourth dorsal compartments. A straight longitudinal incision is centered over the distal radioulnar joint extending distally over the third metacarpal. The dorsal intercarpal ligaments are opened sharply, and the articular surfaces that are to be fused are decorticated. The dorsal prominence of the distal radius, lunate, capitate and proximal third metacarpal have to be resected; the compression plate lies flat against the carpal bones (Fig. 7).

At the time of the last follow up, the sensory function of median nerve had returned to normal, whereas the ulnar nerve was still in the score of +1. The patient was able to lift a load of 1 kg and had a strong pinch. There was no contracture on the MCP joints. The patient was undergoing rehabilitation in the physiotherapy unit (Fig. 8).

2. Discussion

Wrist replantations are thought to have the most favourable outcomes among other macroreplantations.¹ Description of the mechanism of injury is critical; not all patients are good candidates for replantations. Those with severe crush or avulsion injuries, multi-level amputations, complex problems which cause impairment of vascular integrity, immune system, and wound healing, and other serious medical problems are typically poor candidates for replantation.¹⁵ On the other hand, amputations resulted from sharp objects are ideal because the zone of injury is largely limited to the amputation site.¹⁶ Our patient had amputation the wrist joint

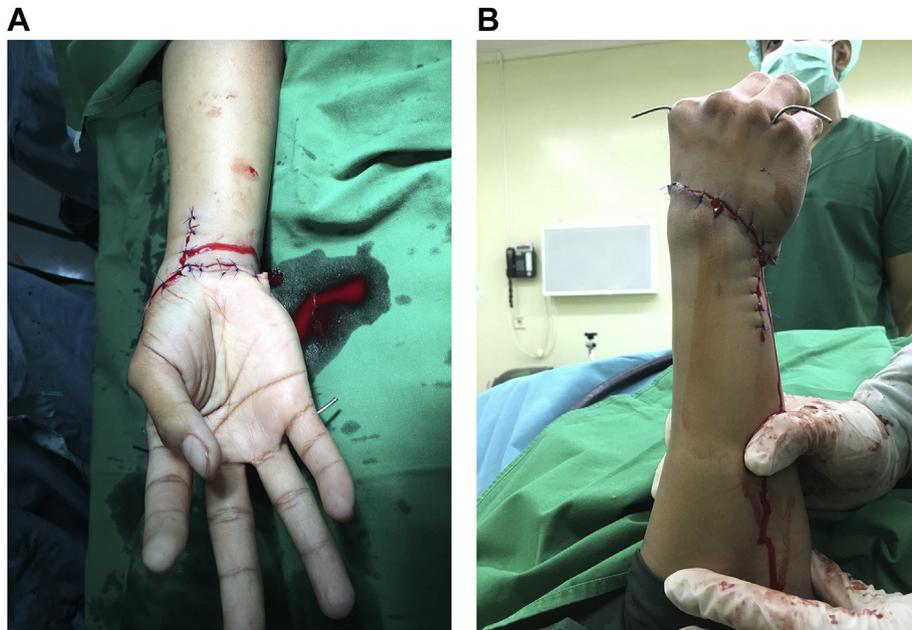


Fig. 4. A. Replanted hand volar, B. Replanted hand dorsum.

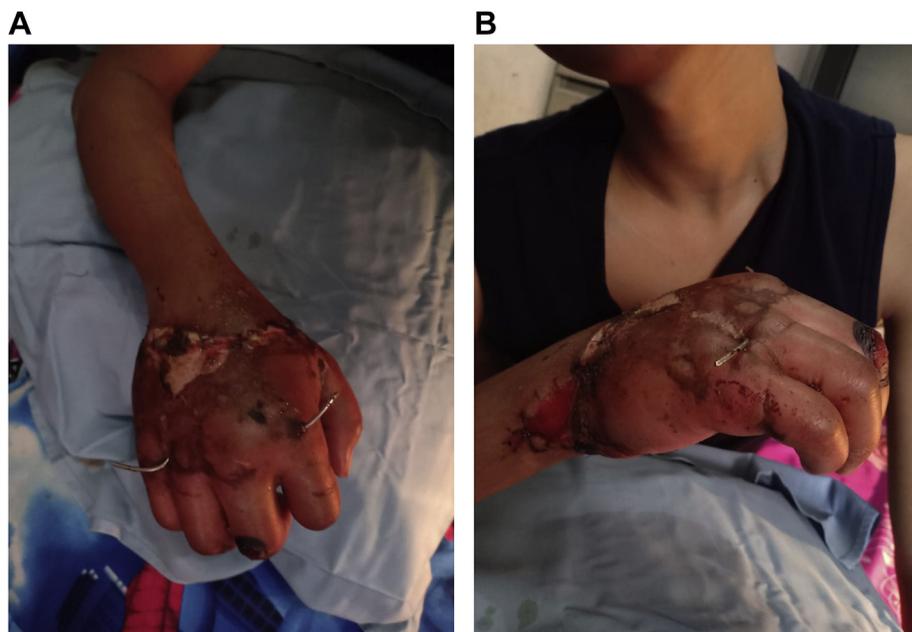


Fig. 5. Clinical presentation of 7 days post-operative follow-up.

level resulting from a sharp object; therefore, he was an ideal candidate for hand replantation than prosthetic rehabilitation.

Wrist amputation should be replanted unless absolute life-threatening contraindications exist, including prolonged ischemia time.¹⁷ Generally, the maximum limits of ischemia times for major injuries from the level of shoulder to the wrist are 6 hours and 12 hours for warm and cold ischemia, respectively.^{16,18} Ischemia time is an important factor that affects the success of limb replantation¹⁹; in this case, the patient presented to the emergency department 7 hours after amputation and the amputated part was obtained 1 hour after. This was a major challenge as the success of replantation procedure depends highly on the ischemia time.

However, the patient had favourable outcomes despite prolonged ischemia time. Several studies reported successful replantation after a prolonged time period.^{20–22} In particular, some reports have shown that digits may be successfully replanted after prolonged period of cold ischemia. However, replantation at more proximal levels is associated with more problems including myonecrosis, which may causes infection and renal toxicity due to myoglobin products.¹⁶ Nevertheless, some studies have also shown favourable outcome of wrist replantation despite prolonged ischemia time. Lin et al.²² reviewed 14 patients undergoing 25 replantations after prolonged ischemia of more than 24 hours, and they reported a success rate of 64%. Vanderwilde et al.¹⁹ successfully performed

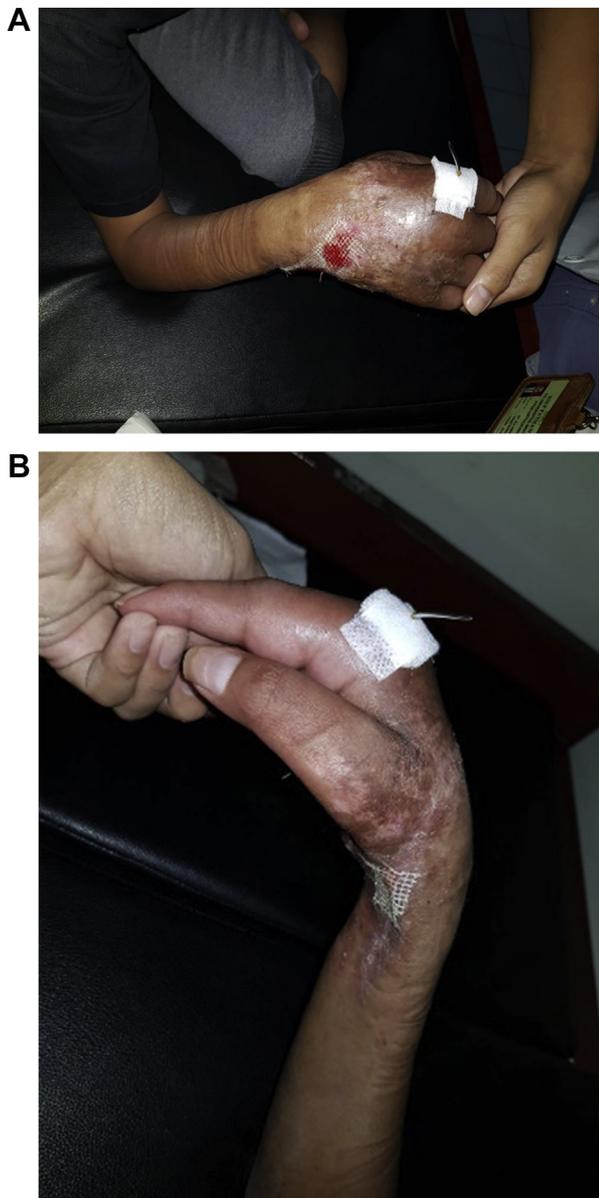


Fig. 6. Clinical presentation of 6 months post-operative follow-up.

hand replantation after 54 hours of cold ischemia in a 15-year-old female with sharp blade injury to the wrist. Hoang⁹ performed radiocarpal joint replantations in five patients within 9–14 hours of injury. The patients had 70–80% Total Active Motion (TAM) of the digits and thumb opposition compared with the contralateral hand and 8–12 mm of two-point static discrimination during a mean follow-up of 33 months.⁹ These findings suggest that the wrist could still be replanted successfully despite prolonged ischemia time. The successful outcome of wrist replantation despite prolonged ischemia may be due to various tolerance period of each individual, which depends on the severity of the ischemia and the presence of collateral blood flow.

Intraoperatively, debridement is the single most important step

in reconstruction procedure. A thorough debridement was performed to determine if the replantation effort is feasible. Debridement would also determine healthy tissue and what modification would be needed.¹⁶ It is recommended to perform bone shortening to reduce tension across the neurovascular repairs for ease of soft tissue closure.¹⁸ With sharp amputations, the amount of shortening is 2.5–3.5 cm, with even greater amounts for crush avulsion injuries.¹⁶ In our case, involvement of carpal bones posed an additional difficulty as bone shortening is limited. Afterwards, preliminary fixation with K-wires, small plates, or simple external fixators is done while definitive fixation is determined by the urgency for revascularization. Reestablishment of arterial inflow is performed directly in those cases with ischemic times greater than 6 hours, while in cases with ischemic times less than 6 hours definitive rigid internal fixation is performed before proceeding revascularization.¹⁶ Our patient had the ischemic time about 7 hours. Definitive fixation by K-wires was placed to stabilize the fracture before revascularization.

Several months later, the patient complained of pain in the replanted wrist. This pain may associate with his history of trauma and surgery, leading to secondary osteoarthritis. In order to relieve the pain, wrist arthrodesis was taken as the treatment of choice. We decided to perform this as the patient was a highly active young individual who required fast recovery. Weiss et al.²³ surveyed post wrist arthrodesis patient to evaluated functional outcome. This study showed that the majority of the patient achieved good result proven by 15/23 of the subjects back to the previous job. Furthermore, a qualitative assessment was carried out in this study, including X-ray, Jebsen Hand Function, Activity of daily living test, and Buck-Gramco/Lohmann Score. Overall, the result was satisfactory with minor limitation such as difficulty in doing perineal care and manipulating the hand in tight space.

The outcome of surgery has to be assessed by limb survival rate, functional results, and patient acceptability.¹⁸ The functional outcome mainly depends on the restoration of the preserved musculotendinous units, sensation, and tissue coverage. Hoang et al.²⁴ reported 70–80% of TAM compared to contralateral hand in young male patients with clean-cut radiocarpal joint amputations after replanted within 9–14 hours. A recovery of 90% of total active motion and 5–7 mm of static two-point discrimination was reported in children.²⁵ Waikakul et al.¹⁴ have reported satisfactory functional outcomes after wrist joint replantations. In contrast, Patel et al.²⁶ stated that a successful replantation of radiocarpal joint amputation is associated with marked decrease of Range of Movement (ROM), decreased strength and moderate disability on functional outcome assessment using DASH Score, Mayo Wrist Score, Patient-Rated Wrist Evaluation, and Michigan Hand Questionnaire. During post-operative care, no complication was present in our patient.

3. Conclusion

Wrist replantation could lead to progressive improvement in motor and sensory functions. The patient started to exhibit flexion and extension movements at the wrist, metacarpophalangeal and interphalangeal joints and signs of initial sensory recovery. Our patient was satisfied with the replanted hand, which enabled him to do activities of daily living. Further clinical studies are required to investigate the efficacy and safety of this procedure.



Fig. 7. Radiology Examination Post K-wire removal and arthrodesis using plate and screw.

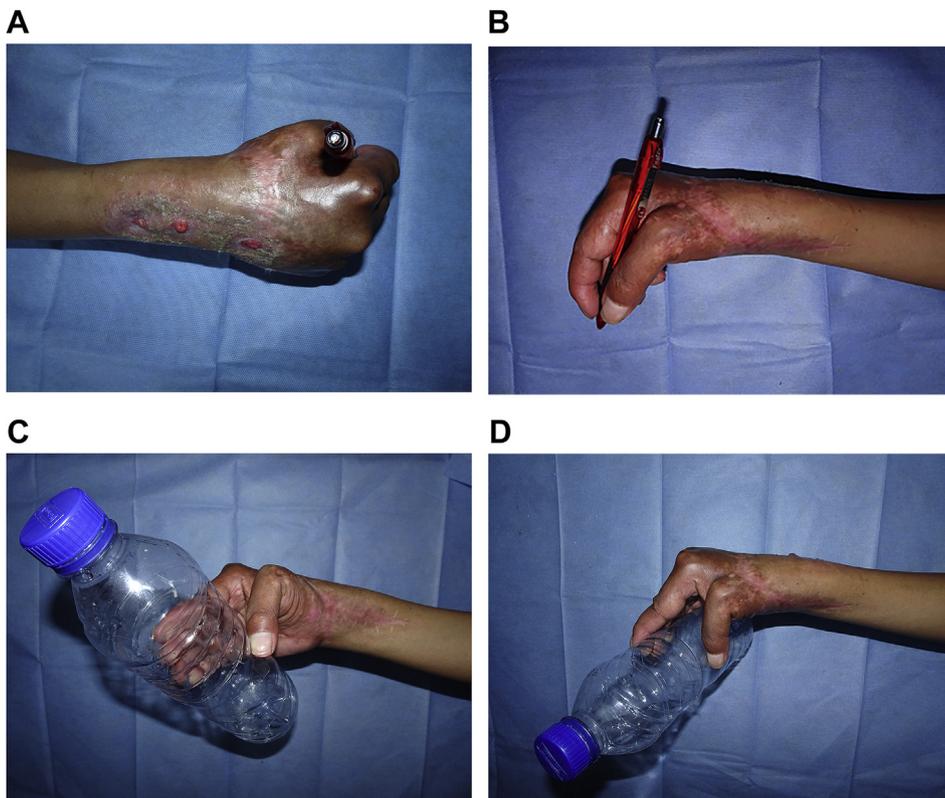


Fig. 8. Clinical Presentation of last follow-up.

Conflicts of interest

None declared.

Acknowledgements

We would like to express our deep gratitude to all contributors and we hereby affirm that there is no conflict of interest regarding this report.

References

- Mittal S, Mahajan R. Functional outcome of patients undergoing replantation of hand at wrist level-7 year experience. *Indian J Plast Surg.* 2013;46(3):555–560.
- Atroshi I, Rosberg HE. Epidemiology of amputations and severe injuries of the hand. *Hand Clin.* 2001;17(3):343–350.
- Tintle SM, Baechler MF, Nanos GP, Forsberg JA, Potter BK. Traumatic and trauma-related amputations: Part II: upper extremity and future directions. *J Bone Jt Surg - Ser A.* 2010;92(18):2934–2945.
- Tintle SM, Baechler MF, Nanos GP, Forsberg JA, Potter BK. Reoperations following combat-related upper-extremity amputations. *J Bone Jt Surg - Ser A.* 2012;94(16):e1191–e1196.
- Fahrenkopf MP, Adams NS, Kelpin JP, Do VH. *Hand Amputations. Eplasty.* 2018;18, ic21.
- Woo SH, Lee YK, Lee HH, Park JK, Kim JY, Dhawan V. Hand replantation with proximal row carpectomy. *Hand.* 2009;4(1):55–61.
- Hodges A, Chesher S, Feranda S. Hand transplantation: rehabilitation: case report. *Microsurgery.* 2000;20(8):389–392.
- Tark KC, Kim YW, Lee YH, Lew JD. Replantation and revascularization of hands: clinical analysis and functional results of 261 cases. *J Hand Surg Am.* 1989;14(1):17–27.
- Hoang NT. Hand replantations following complete amputations at the wrist joint: first experiences in Hanoi, Vietnam. *J Hand Surg Am.* 2006;31(1):9–17.
- Waikukul S, Vanadurongwan V, Unnanuntana A. Prognostic factors for major limb re-implantation at both immediate and long-term follow-up. *J Bone Jt Surg.* 1998;80(6):1024–1030.
- Blomgren I, Blomqvist G, Ejeskär A, Fogdestam I, Volkman R, Edshage S. Hand function after replantation or revascularization of upper extremity injuries. A follow-up study of 21 cases operated on 1979–1985 in Göteborg. *Scand J Plast Reconstr Surg Hand Surg.* 1988;22(1):93–101.
- Chow JA, Bilos ZJ, Chunprapaph B, Hui P. Forearm replantation - long-term functional results. *Ann Plast Surg.* 1983;10(1):15–23.
- Hamilton RB, Maco'brien B, Morrison A, Macleod AM. Survival factors in replantation and revascularization of the amputated thumb-10 years experience. *Scand J Plast Reconstr Surg Hand Surg.* 1984;18(2):163–173.
- Mahajan RK, Mittal S. Functional outcome of patients undergoing replantation of hand at wrist level-7 year experience. *Indian J Plast Surg.* 2013;46(3):555–560.
- Langer V. Management of major limb injuries. *Sci World J.* 2014;2014(5), 640430.
- Hanel DP, Chin SH. Wrist level and proximal-upper extremity replantation. *Hand Clin.* 2007;23(1):13–21.
- Maricevich M, Carlsen B, Mardini S, Moran S. Upper extremity and digital replantation. *Hand.* 2011;6(4):356–363.
- Nanda V, Jacob J, Alsafy T, Punnoose T, Sudhakar VR, Iyasere G. Replantation of an amputated hand: a Rare case report and Acknowledgement of a Multidisciplinary team input. *Oman Med J.* 2011;26(4):279–282.
- VanderWilde RS, Wood MB, Zeng-gui S. Hand replantation after 54 hours of cold ischemia: a case report. *J Hand Surg Am.* 1992.
- Chim H, Maricevich MA, Carlsen BT, et al. Challenges in replantation of complex amputations. *Semin Plast Surg.* 2013;27:182–189.
- Wilhelmi BJ, Lee WPA, Pagensteert GI, Jr JWM. Replantation in the mutilated hand. *Hand Clin.* 2003;19:89–120.
- Lin C-H, Aydyn N, Lin Y-T, Hsu C-T, Lin C-H, Yeh J-T. Hand and finger replantation after protracted ischemia (more than 24 hours). *Ann Plast Surg.* 2010;64(3):286–290.
- Weiss APC, Wiedeman G, Quenzer D, Hanington KR, Hastings H, Strickland JW. Upper extremity function after wrist arthrodesis. *J Hand Surg Am.* 1995;20(5):813–817.
- Mattiassich G, Rittenschober F, Dorninger L, et al. Long-term outcome following upper extremity replantation after major traumatic amputation. *BMC Musculoskelet Disord.* 2017;18(1):1–9.
- El-Sayed Ahmed MM. Hand replantation: a rare case report. *SAGE Open Med Case Reports.* 2013;1, 2050313X1351160.
- Patel AA, Blount AL, Owens PW, Askari M. Functional outcomes of replantation following radiocarpal amputation. *J Hand Surg Am.* 2015;40(2):266–270.