

## True proximal third arm replantation: A rare case

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### ABSTRACT

Proximal arm replants are devastating injuries which leave significant disability for the patient. Replantation of proximal limb injuries is widely considered to have poor results, especially so of the proximal third of the arm due to the difficulty in anastomosis of the vessels in the axilla. Furthermore, crush avulsion injuries have a much worse prognosis than clean-cut injuries. Here, we present the successful replantation of a true proximal crush amputation of the upper limb at the level of proximal third arm with satisfactory results in a 19-year-old male.

**Key words:** *Amputation, Microsurgery, Replantation, True proximal third amputation, Upper limb crush injury*

The functional outcome of a replantation surgery varies greatly with the level of injury. The general dictum is that the more distal the injury, the better the outcome. Conversely, proximal injuries have been handled with the trepidation of impending failure. Proximal injuries in the arm have been used loosely to define any upper half injuries of the arm. However, a true proximal arm amputation is defined as an amputation from the proximal upper-third of the humerus. True proximal injuries of the upper limb have suffered from this dismal outlook, with surgeons more inclined toward amputation than attempt a surgery that is not only labor intensive but also seems unlikely to succeed. Although modern prosthetic devices have improved over recent years, high rejection rates are still observed in patients supplied with prostheses; thus, replantation of the lost extremity is still believed to yield better overall subjective results.[1]

Here, we report the case of a successful replantation of a true proximal arm injury. We hope to challenge the negative outlook associated with proximal limb injuries and encourage more surgeons to attempt to salvage the limb whenever possible.

### CASE REPORT

A 19-year-old male patient sustained a total amputation at the level of the right upper third arm after his upper limb got entangled in a crusher machine in an occupational injury on November 3, 2015. The patient had complete avulsion of his upper limb with disruption of the skin, soft tissues, muscles, vessels, nerves, as well as a fracture of the humerus in the proximal third (Figs 1 and 2). The patient had no other injuries and was otherwise fit and healthy. The patient had lost a lot of blood when he reached the hospital and immediate resuscitative measures were instituted. The avulsed stump was later brought

in by a bystander. A discussion about replantation attempt was done with the patient's relatives, and a decision was made for emergency replantation.

The patient was in hypovolemic shock with a very feeble pulse rate of 140/min and blood pressure of 60/40 mmHg. The patient was resuscitated with intravenous fluids and colloids, and then, the systolic blood pressure came to 80–90 mmHg. The patient was shifted to the operation theater and immediate preparation of the amputated arm was performed while the patient was being stabilized. The amputated arm was washed copiously with normal saline and all foreign material was removed. The vessels and nerves were identified and tagged. The bone was cleared for about 5 cm to facilitate quick fixation. After general anesthesia, the stump was debrided and neurovascular structures were identified and tagged.

The humerus was shortened by about 2.5 cms, and a stable osteosynthesis with a 4.5-mm plate was performed. Subsequently, an anastomosis of one deep vein was performed under magnification with 8-0 polypropylene sutures. The venous anastomosis was done before the arterial anastomosis to reduce blood loss after arterial revascularization. The axillary artery was then anastomosed under magnification and the clamps were released. Successful revascularization was achieved within 4 h of the trauma. There was good flow in the vein and distal vessels post-anastomosis. Two more veins were anastomosed and hemostasis was achieved. Then, an epineural repair of the radial, ulnar, and median nerves was performed using microneural techniques. The muscles were repaired. A fasciotomy of the lower arm and carpal tunnel release were also performed. The proximal wound was covered with skin graft after covering the neurovascular structures with muscle. The distal wounds were repaired, and the procedure was completed in about 6 h (Fig. 3).



Figure 1: Complete amputation of the arm at the proximal third level with avulsed neurovascular bundles



Figure 2: Avulsion amputation at proximal third arm level



Figure 3: Immediate post-operative picture showing good vascularity

Postoperatively, the patient showed good capillary filling of the fingers and bright red blood on pinprick. Heparin therapy was instituted postoperatively. Continuous monitoring of the patient was done in the immediate post-operative period. There was some proximal skin loss at the site of amputation where there was severe pre-operative crushing. This was treated with skin grafting and the wound settled well. Once all the wounds had healed, the patient was referred for rehabilitation. The patient showed good progress in the shoulder and elbow



Figure 4: 6 weeks post-operative picture showing well settled replanted upper limb



Figure 5: Post-operative picture showing (a) good shoulder movements and (b) satisfactory elbow and wrist movements

movement and slight movements of the thumb and fingers (Fig. 4).

Two years after the trauma, the sensitivity of the fingers was regained. He displayed a good capacity for shoulder and elbow motion. Wrist movement was possible, but finger movements were significantly reduced (Fig. 5). Although the patient was unable to return to his previous work after the injury, he was satisfied with the procedure and confirmed that he would opt for replantation again if needed. He is able to independently perform daily activities and has joined work as a supervisor.

## DISCUSSION

Reimplantation is the reattachment of a completely severed body part and involves reconstruction of all the separated components of an extremity, including arteries, nerves, and veins [2,3]. The success of a replantation is not only merely anatomic survival of the body part but also the functional capability of the rescued limb. Functional outcomes are known to vary greatly with the level of amputation [4]. Hand and digit replantation are fairly common procedures now, with well-defined indications and

contraindications, and a high percentage of success [5]. However, above-elbow amputations are less common, and indications for replantation less clear [5,6]. The general dictum is that the more distal the injury, the better the outcome of replantation [7]. This is because the more proximal the injury, the greater the muscle mass, and muscle does not tolerate ischemia well [6-8]. Another major reason for poor outcome in proximal reimplantation is difficulty in restoring nerve function, resulting in joint stiffness, joint instability, infections, and skin and muscle necrosis [3,8,9].

Proximal reimplantation of the upper limb is a complex surgery and demands a high degree of surgical skill. The difficulties in anastomosing the vessels inside the axilla in very high amputations of the arm make these cases particularly challenging. This is, especially, true for crush injuries, where the technical demand is high, the surgical duration is long, and the tissue condition is suboptimal [6,8,9]. These conditions combined with the cost involved and the poor prognosis associated often lead to the surgeon considering amputation to be a better option. However, the loss of an upper limb not only has a very significant negative effect physically but also severely impacts the patient psychologically. The stigma of physical impairment and the negative outlook regarding gainful employment, lifestyle, and self-care brings on a tremendous psychological stress on the patient [10]. Furthermore, unlike lower limb prosthesis, even the latest upper limb prosthesis offers only suboptimal function by any measure. Despite the increased cost, longer post-operative care, and higher potential for secondary infection or secondary operations, reimplantation if successful provides a limb that affords the patient a level of function and independence far superior to any prosthesis [10,11].

Patients suffering an amputation usually demand reattachment without any appreciation of the implications. The patient must be aware of the possibility of failure, prepared for the lengthy hospital stay and rehabilitation, financial implications, family hardships, and psychological stress [5]. Like any surgical procedure, patient selection is important, and reimplantation criteria include the essential structures of the amputated part which are well preserved, the cold ischemia time of the severed limb at normal temperature which should not exceed 4 h, and the warm ischemia time which should be ideally less than an hour. The patient should be in good general health without any serious associated injuries or systemic disorders.

The experience and skill of the surgeon and the availability of required instruments and an operating microscope are other important considerations. If these criteria are fulfilled, then all attempts should be made to provide the patient with a functional limb [12]. Ultimately, it is functionality and not anatomic survival that is important, and hence, meticulous anastomosis of the vessels and repair of nerves and musculotendinous units primarily are of utmost importance. In general, the order of tissue repair is as follows: Bone, tendons, artery, nerve, vein, and skin. However,

in proximal replants, we prefer to anastomose the vein before the artery so as to reduce the blood loss after revascularization.

Post-operative care is also very important and there is a risk of reperfusion injury which one should be careful about. Adequate hydration, probable need for diuresis, wide antibiotic cover, and maintenance of hemodynamic parameters are the mainstay of post-operative management. Structured physiotherapy also plays a very important role to restore the function of the arm.

## CONCLUSION

Meticulous surgery followed by stringent post-operative care can give very rewarding results even in cases of crushed avulsion major limb amputations dramatically improving the quality of life of the patient. Here, our patient made a remarkable recovery despite battling the odds of two negative prognostic factors of being a true proximal injury, as well as the mechanism of amputation being a crush avulsion injury. Although this is only a case report and further studies are undoubtedly required, it is worthwhile to note that we should not allow the negative prognosis to intimidate us from doing our best to salvage the limb.

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