

Utilization of arterial grafts in foot replantation

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Our subject is a 36-year-old man who presented to the emergency department with bilateral lower extremity amputation at the level of the distal third of the tibia after a car accident. Surgery was planned for below-knee amputation of the right lower extremity and replantation of the left foot. The arteries dissected from the iatrogenically amputated segment were used as grafts to repair vascular gaps during the replantation. The patient's follow-up had been problem free. We concluded that whenever possible, amputated parts unsuitable for replantation should be examined thoroughly and neurovascular structures that might be used as grafts should be preserved. (*J Vasc Surg Cases and Innovative Techniques* 2017;3:44-6.)

The success rate of replantations after major extremity amputations has been increasing recently thanks to gained experience in the microsurgical field and recent developments in microsurgical techniques and instruments. However, as the industrialization spreads and becomes varied over time, the incidence and the nature of the injuries also increase and diversify. Crush and avulsion-type injuries are encountered more frequently nowadays. Our subject is a 36-year-old man who presented to the emergency department with bilateral lower extremity amputation at the level of the distal third of the tibia after a car accident.

The patient gave informed consent for all his information and images to be shared and published.

METHODS

A 36-year-old male patient presented to the emergency service with bilateral lower extremity amputation at the level of the distal third of the tibia as a result of a car accident, which took place approximately 2 hours before his arrival. Both amputated feet and stumps were evaluated for replantation. The Mangled Extremity Severity Score (MESS) was calculated as 9, and both amputated feet and stumps were found to be extensively damaged. There was marked vascular injury at multiple levels on the right foot in particular (*Fig 1*). Surgery was planned

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for below-knee amputation of the right lower extremity and replantation of the left foot. Below-knee amputation of the right leg provided us with an uninjured proximal segment of the leg. Instead of creating a second donor site and thus secondary morbidity, we preferred to use the arteries at that segment, which we considered healthy and reliable. The neurovascular structures in the iatrogenically amputated segment of the right leg were meticulously dissected to be used as grafts during replantation of the left foot. The left amputated foot and the left leg stump, which were contaminated with soil, were débrided thoroughly (*Fig 2*). The posterior and anterior tibial arteries and posterior tibial nerve were dissected and prepared for anastomosis and coaptation, respectively. The arteries were resected both proximally and distally. The longest resected segment was 2.5 cm. After the resections, all the vessels were free of visible endothelial damage. The anterior and posterior tibial veins were also damaged and their ends were débrided meticulously until the lumen of the veins was evaluated as intact and free of visible injury. We observed that the veins were more intact and less of a problem compared with the arteries. There was no need to interpose the veins because the length of the bone stump was shortened by the orthopedic team to facilitate arthrodesis of the ankle. There was a gap ranging from 2 to 5 cm between each vessel prepared for anastomosis. Each of them including the veins was repaired with arterial grafts obtained from the contralateral leg. All anastomoses were patent, and capillary refill was present at the most distal part of the foot. A 4-cm gap between the proximal and distal ends of the posterior tibial nerve was repaired with a nerve graft taken from the contralateral amputated segment. Fasciotomies were done over the second and fourth intermetatarsal spaces. After completion of replantation, tissue defects on the foot were covered with full-thickness skin grafts obtained from the amputated right leg.

RESULTS

During the postoperative period, no problem was encountered in terms of arterial and venous circulation.



Fig 1. The right foot, which was evaluated as unsuitable for replantation because of vascular damage at multiple levels.



Fig 2. The left foot, which was replanted.

All the skin grafts that were transplanted at the replantation procedure were eliminated. On postoperative day 10, the patient was taken to the operating room again for débridement of all the necrotic tissues and for negative pressure wound therapy to be applied. After the establishment of granulation tissue, the defect was covered with skin grafts. The patient's recovery was problem free from the reconstructive surgery perspective, and he was discharged on postoperative day 58 (Fig 3). He was followed up on a biweekly basis in the outpatient clinic. The patient has decided to continue his orthopedic treatment in another hospital for personal reasons. There he underwent an intramedullary fixation procedure and was followed up in a cast. Meanwhile, he started to wear a below-knee prosthetic leg on the right side.

DISCUSSION

Major traumatic amputation of the lower extremity is a life-threatening condition. Although there is no definitive algorithm in the literature to decide whether replantation should be performed, the MESS is used frequently for this purpose. In many centers, patients with a MESS ≥ 7 might undergo amputation.¹ In patients with bilateral



Fig 3. Appearance of the left lower extremity at the time of discharge from the hospital.

extremity amputation, at least unilateral replantation should be considered strongly.² Schmidhammer et al also concluded that the decision between replantation and prosthetic replacement after bilateral lower leg amputation is case related and cannot be generalized.³ Despite the MESS of our patient, which was 9, he underwent a unilateral replantation procedure because he was young, was a nonsmoker, and had no chronic illness. Amputations resulting from crush or avulsion-type injuries, which are major risk factors for thrombus formation, are seen frequently in the plastic surgery field. To prevent postoperative thrombus formation, all the segments with endothelial damage must be excised aggressively under the microscope before the anastomosis. In a study of Mitchell et al, after an avulsion-type injury was created in rats' extremities, the visible damage on the vessel wall was measured as 0.8 cm. When the damage was further examined histologically, it was found that the length of the damage was actually 4 cm.⁴ Use of vein grafts is necessary if there is gap formation after débridement of vessel ends or possible tension at the anastomosis region during the primary repair. Studies regarding vein grafts showed that because of the migration of vascular smooth muscle cells in the vein grafts, the tunica media thickens and neointima formation occurs.⁵ There are many studies aiming to prevent this situation.

Venous insufficiency after replantation or revascularization procedures is one of the most common causes of failure in both the short and long term.⁶ In replantation procedures, the chance of success is below 20% if no vein anastomosis is performed.⁷ The superficial localization of the veins makes them more susceptible to injury. Moreover, the walls of veins are fragile; they can be easily traumatized, and they also have a tendency for spasm because of increased sensitivity to temperature. All these factors contribute to the risk of occlusion and thrombosis in veins.⁶

There are several main differences between arterial and venous structures inherently. Veins are more likely to be affected by vasoactive substances compared with

arteries.⁸ The vasa vasorum are the only blood supply to the veins, whereas arteries are supplied by both vasa vasorum and their lumens.⁹ The endothelium of an artery releases more relaxing factors than a vein does.¹⁰ Also, the arterial wall can handle higher blood pressures.⁶ All these differences indicate clearly that arteries have obvious advantages as a vascular graft. Saha et al and Aryal et al also suggested that arterial grafts are superior to vein grafts.^{6,11} There are other examples of autologous arterial graft use as well.¹² However, use of autogenous artery to bridge gaps in venous continuity is distinctly uncommon and requires further explanation. We believe that using arterial grafts contributed to our success at foot replantation.

CONCLUSIONS

Whenever possible, amputated parts unsuitable for replantation should be examined thoroughly and neurovascular structures that might be used as grafts should be preserved.

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