



Reconstruction of Chopart's Amputation Stump Using Artificial Dermis Combined with Free Anterolateral Thigh Flap

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Summary: A 63-year-old man dropped a metal chunk onto his left foot during his work and suffered a crush injury of the left forefoot. He underwent Chopart's amputation followed by stump coverage with sole skin at the orthopedic department on the same day. He was referred to our department for reconstruction because of poor vascularization and subsequent necrosis of tissue at the stump. After the necrotic tissue was debrided, exposure of the talus bone was noted. An artificial dermis was then applied to the stump wound, followed by local negative pressure wound therapy. After 3 weeks, the generation of a strong dermis-like tissue was observed at the site of artificial dermis grafting. We then performed flow-through free anterolateral thigh flap grafting to reconstruct the stump wound. This procedure involved suturing of the peroneal muscle group and tibialis anterior muscle, which were cut off during Chopart's amputation, and suturing the soft tissue surrounding the calcaneus firmly to the fascia lata of the anterolateral thigh flap, followed by suturing of the flap to the skin defect of the left foot. There were neither postoperative complications, such as skin ulcer and equinus/varus deformity, nor need for secondary repair of the grafted flap, so the patient was able to smoothly enter a rehabilitation program including gait training. The current reconstruction technique for the tissue defect following Chopart's amputation, consisting of artificial dermis grafting, negative pressure wound therapy, and flow-through free anterolateral thigh flap grafting, enabled safe and smooth gait rehabilitation with a forefoot prosthesis. (*Plast Reconstr Surg Glob Open* 2015;3:e558; doi: 10.1097/GOX.0000000000000547; Published online 17 November 2015.)

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Received for publication July 6, 2015; accepted September 23, 2015.

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DOI: 10.1097/GOX.0000000000000547

Chopart's amputation is a disarticulation between the navicular/cuboid bones and the talus/calcaneus bones—a foot amputation procedure performed at the most proximal level.¹ It is an established leg amputation procedure applicable to traumatic injuries, legs with chronic arterial obstruction, and other orthopedic conditions,² but its selection is less common compared with other foot amputation procedures due to the high risk of postoperative equinus/varus deformity.^{1,3} Moreover, the procedure is often associated with postoperative damage, defects, and/or poor vascularization of the surrounding tissue, making it difficult to cover the

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

amputation stump with soft tissue in some cases.¹ In such cases, alternative approaches should be explored, such as reconstruction by free tissue grafting to the amputation stump⁴ or secondary wound closure by negative pressure wound therapy (NPWT).⁵ In severe cases in which stump coverage with soft tissue has failed, the decision to give up preservation of the heel and perform a higher level leg amputation may be made.^{4,6,7} We report a case of postoperative extensive necrosis of the tissue covering the stump after Chopart's amputation of an injured foot. It was successfully treated by secondary stump reconstruction with the combined use of an artificial dermis and anterolateral thigh (ALT) flap.

CLINICAL CASE

A 63-year-old man dropped a metal chunk onto his left foot during his work and suffered a crush injury of the left forefoot. The severe crush injury affected the area distal to the dorsum of the left foot, so Chopart's amputation followed by stump coverage with sole skin was performed on the same day. On day 28 postinjury, the skin of the stump showed mosaic discoloration, suggesting poor vascularization of the covering skin flap (Fig. 1). On day 53 postinjury, a necrotic area at the stump was clearly distinguishable from the surrounding tissue and was debrided. This was followed by nylon suture marking of the tibialis anterior muscle and peroneal muscle group, which were cut off during Chopart's amputation. During this procedure, exposure of the talus bone was noted (Fig. 2), and it was covered by placing an artificial dermis (Pelnac; Smith & Nephew Wound Management, London, U.K.) onto the stump wound, followed by NPWT at -125 mm Hg (V.A.C. Therapy; KCI, San Antonio, Tex.). On day 74 postinjury, after confirming the presence of a strong dermis-like tissue at the grafted site (Fig. 3),



Fig. 1. Appearance of the amputation stump on day 28 postinjury. Necrosis of the skin and soft tissue covering the Chopart's amputation stump was noted.



Fig. 2. Appearance of the amputation stump on day 53 postinjury. A necrotic area at the stump was clearly distinguishable from the surrounding tissue and was debrided.

we performed free ALT flap grafting to reconstruct the stump wound. A 160×130 -mm ALT flap in the left thigh was elevated with a single intermuscular perforator as the vascular pedicle. The donor artery was elevated as a T-portion with the main trunk and ascending branch of the lateral femoral circumflex artery. The peroneal muscle group and tibialis anterior muscle, which were cut off during Chopart's amputation, and the soft tissue surrounding the calcaneus were firmly sutured to the fascia lata included in the ALT flap, followed by suturing of the flap to the skin defect of the left foot. The T-portion of the flap artery was anastomosed to the posterior tibial artery to form a flow-through circulation, while 2 veins were anastomosed to the great saphenous and posterior tibial veins (Fig. 4). After the operation, the patient started weight bearing 3 weeks postoperatively. He was transferred to a rehabilitation hospital and entered a rehabilitation program so that he could walk with a forefoot prosthesis. Two years



Fig. 3. Appearance of the amputation stump on day 74 postinjury. After the necrotic tissue was debrided, artificial dermis grafting was performed and the generation of a strong dermis-like tissue was noted at the grafted site.



Fig. 4. Appearance of the amputation stump during free anterolateral thigh flap grafting. The T-portion of the flap artery was anastomosed to the posterior tibial artery to form a flow-through circulation, while 2 veins coursing along the descending branch of the lateral femoral circumflex artery from the flap were anastomosed to the great saphenous and posterior tibial veins in an end-to-end fashion.

after the operation, there have been no postoperative complications, such as skin ulceration and equinus/varus deformity. Secondary repair of the grafted flap was not needed (Fig. 5).

DISCUSSION

We identified the following 4 possible reasons for the good postoperative outcome after reconstruction of the tissue defect following Chopart's amputation with the combined use of an artificial dermis and ALT flap. The first point is the use of a free ALT flap for reconstruction. In a report of 9 cases of reconstruction of the post-leg amputation stump with a free ALT flap, Yildirim et al⁸ suggested that the thinness and flexibility of the flap eliminated the need for the secondary repair of the prosthesis applied

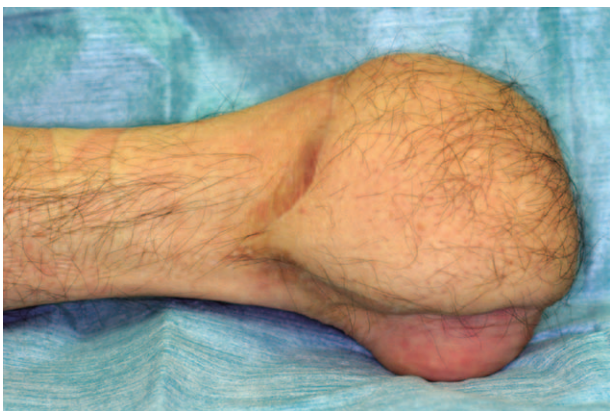


Fig. 5. Appearance of the amputation stump 1 year after skin flap grafting. The Chopart's amputation stump was covered by a strong and flexible flap skin, with no postoperative complications such as skin ulcer and equinus/varus deformity.

to the reconstructed forefoot stump. In the present case, no secondary operation, such as volume reduction, was needed after surgery, and the rehabilitation program was smoothly conducted from the preparation and wearing of a prosthesis to gait training. The second point is that secondary ankle deformity following Chopart's amputation was prevented by a special suturing technique applied to the fascia lata. Chopart's amputation often results in equinus/varus deformities of the ankle, and these deformities may lead to callus/ulcer formation at the stump, which often precludes walking.⁷ In the present case, the tibialis anterior muscle and the peroneal muscle group, which were cut off during Chopart's amputation, were sutured to the fascia lata in the flap to ensure balance of the antagonistic muscle, thereby preventing equinus/varus deformity. The third point is the use of a flow-through arterial anastomosis technique for the flap transplantation. A number of reports have shown that free tissue grafting with flow-through vascular anastomosis enables coverage of a tissue defect while preserving blood flow to the distal parts.⁹ In the present case, the reconstruction of the bone stump with preservation of the posterior tibial artery might have led to the absence of deep ulcer formation at the weight-bearing part.

The fourth point is the mechanical strength of the grafted tissue in the present technique. Molnar et al¹⁰ have suggested that an artificial dermis grafting combined with NPWT promoted the proliferation of collagen fibers. In the present case, the exposed bone stump was treated, with formation of a strong dermis-like tissue with the use of an artificial dermis combined with NPWT, followed by grafting of a free ALT flap to which the fascia lata was attached. We speculate that this reconstruction technique provided sufficient mechanical strength to the reconstructed amputation stump and thus prevented postoperative ulcer formation caused by shearing force during walking.

CONCLUSION

A tissue defect following Chopart's amputation was successfully reconstructed with an artificial dermis combined with ALT flap. The current technique provided sufficient resistance to weight bearing and enabled walking without postoperative complications.

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REFERENCES

1. Lange TA, Nascia RJ. Traumatic partial foot amputations. *Clin Orthop Relat Res.* 1984;185:137–141.
2. Takeda K, Yoh S, Ogata K, et al. Chopart's joint amputation for gangrene of the foot. *West Jpn Soc Orthop Traumatol.* 1997;46:381–385.
3. DeGere MW, Grady JF. A modification of Chopart's amputation with ankle and subtalar arthrodesis by using an intramedullary nail. *J Foot Ankle Surg.* 2005;44:281–286.
4. Isik S, Güler MM, Selmanpakoğlu N. Salvage of foot amputation stumps of Chopart level by free medial plantar flap. *Plast Reconstr Surg.* 1998;101:745–750.
5. Armstrong DG, Lavery LA; Diabetic Foot Study Consortium. Negative pressure wound therapy after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet* 2005;366:1704–1710.
6. Krause FG, Pfander G, Henning J, et al. Ankle dorsiflexion arthrodesis to salvage Chopart's amputation with anterior skin insufficiency. *Foot Ankle Int.* 2013;34:1560–1568.
7. Krause FG, Aebi H, Lehmann O, et al. The “flap-shaft” prosthesis for insensate feet with Chopart or Lisfranc amputations. *Foot Ankle Int.* 2007;28:255–262.
8. Yildirim S, Calikapan GT, Akoz T. Reliable option for reconstruction of amputation stumps: the free anterolateral thigh flap. *Microsurgery* 2006;26:386–390.
9. Koshima I, Fujitsu M, Ushio S, et al. Flow-through anterior thigh flaps with a short pedicle for reconstruction of lower leg and foot defects. *Plast Reconstr Surg.* 2005;115:155–162.
10. Molnar JA, DeFranzo AJ, Hadaegh A, et al. Acceleration of Integra incorporation in complex tissue defects with subatmospheric pressure. *Plast Reconstr Surg.* 2004;113:1339–1346.