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CASE REPORT

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Use of a pedicled fillet foot flap for knee preservation in severe lower extremity trauma: A case report and literature review

David Jensson, Thorir Audolfsson, Maria Mani and Andres Rodriguez-Lorenzo

Department of Plastic and Maxillofacial Surgery, Institute of Surgical Sciences, Uppsala University and Uppsala University Hospital, Sweden

ABSTRACT

We report the sequential use of a pedicled fillet foot flap in a clinical case of complex bilateral lower extremity trauma to achieve stable wound closure, maximizing length preservation and gait rehabilitation. In addition, we perform a literature review of the use of fillet foot flaps in lower extremity trauma.

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Introduction

Large clinical studies have shown that the severity of soft tissue injury has the greatest impact on decision making regarding limb salvage versus amputation in high-energy lower extremity trauma [1,2]. Management of complex trauma affecting both extremities is challenging and often requires a customized strategy to optimize as much as possible the functionality of the extremities. When amputation is necessary, preservation of the knee should be performed, if possible, since it is mechanically more favorable for gait rehabilitation, and it corresponds with lower energy cost of walking and better functional gait [3]. However, in case of inadequate soft-tissue coverage, a below-knee amputation can result in a complicated post-operative course and difficult prosthesis fitting, and then often leading to a thigh amputation. Thus, if knee preservation is attempted, a durable tissue coverage achieve protective sensibility to the stump is critical for successful compliance with the prosthesis. In that regards, the use of tissue from amputated or non-salvageable limb for reconstruction of complex defects (known as ''spare part'' surgery) has the advantage of no donor-site morbidity and it allows the preservation of the knee. The fillet foot flap has been described as a pedicled or microsurgical free flap [4] and in the clinical scenario of bilateral lower extremity, trauma presents several advantages. In this article, we report a case of a patient who suffered a bilateral high energy crushing trauma to his lower extremities. We describe our sequential approach by using a fillet foot flap for primary stump closure and knee preservation along with a review of the literature by using fillet foot flaps in lower extremity reconstruction.

Case Report

A 55-year-old man sustained bilateral below-knee crush injuries after being run over by a bus. He sustained bilateral severe lower extremity trauma, including a Gustilo IIIB tibial and fibula fracture, medial femoral epicondyle fracture and first metatarsal bone fracture in his left leg and a Gustilo IIIC tibial and fibula fracture in his right leg.

During admission, the patient's right foot showed early signs of ischemia that were confirmed by angiography showing arterial occlusion at the level of the popliteal artery. A stent was placed at the level of the occlusion and perfusion of the extremity was achieved. Surgical exploration of the right leg showed extensive avulsion injury and swollen muscles with the sign of ischemic injury, and fasciotomy was performed in all compartments. Foot sensation was preserved. Fracture repositioning and external fixation was applied bilaterally. On the second day after admission, the patient suffered lung emboli that required treatment with

CONTACT Andres Rodriguez-Lorenzo, MD, PhD a.rodriguez.ps@gmail.com Director of Microsurgery, Department of Plastic and Reconstructive Surgery, Uppsala University Hospital, Uppsala Sweden

anticoagulants, and, therefore, delayed the definitive reconstruction.

In the next three weeks, the patient underwent serial revisions of necrotic tissues. On the right side, a large portion of the skin from the thigh to the distal third of the lower leg as well as the gastrocnemius and soleus muscles were debrided, resulting with a large circular defect of the leg with exposure of the posterior tibial neurovascular pedicle and the tibia bone. On the left side, after debridement, the soft tissue defect measured 18×16 cm on the lateral lower leg with tibia exposure (Figure 1). A temporary coverage with split-thickness skin graft was performed in the right side, and vacuum-assisted closure (VAC) device was placed in the left lower leg. Reconstruction was planned in two stages by spare-parts surgery with preservation of the knee in the right side and free-muscle flap on the left side.

Figure 1. Photograph of the injury three weeks after admission showing extensive soft-tissue and muscle loss in the right lower extremity (above) and soft tissue loss with exposure of the tibial bone in the left extremity (below).

A below-knee amputation of his right leg with a pedicled fillet of foot flap reconstruction for length preservation was performed three weeks after trauma. The flap was based on the anterior tibial neurovascular bundle and dorsalis pedis skin. All bone was dissected from the flap, the sole and remaining gastrocnemius and soleus muscle where excised because of inadequate circulation. The dorsal site of the foot was used as a cover over the proximal tibia stump. Remaining wound surfaces were tread with vacuum therapy. Six days after amputation, the patient got a split-thickness skin graft on the remaining wound surfaces on the stump (Figures 2 and 3). Internal fixation with an endomedullary nail was performed simultaneously in the left tibial fracture.

Five weeks after admission, a free gracilis muscle flap was used to reconstruct the defect on the left lower leg.

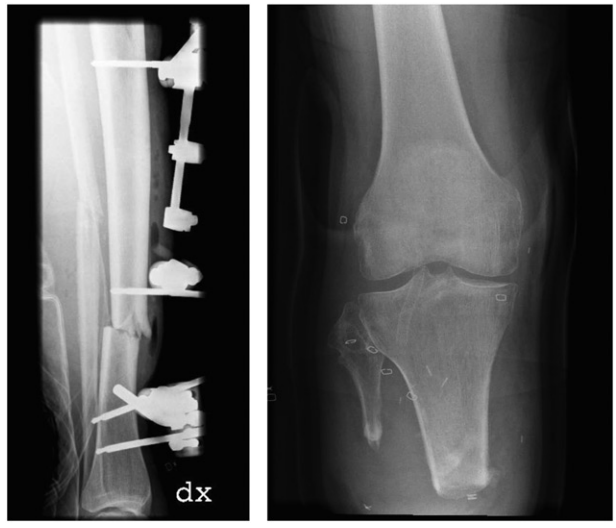

Figure 3. Radiographs showing the level of fracture in the left leg preoperatively (*on the left*) and after below-knee amputation and fillet foot flap (*on the right*).

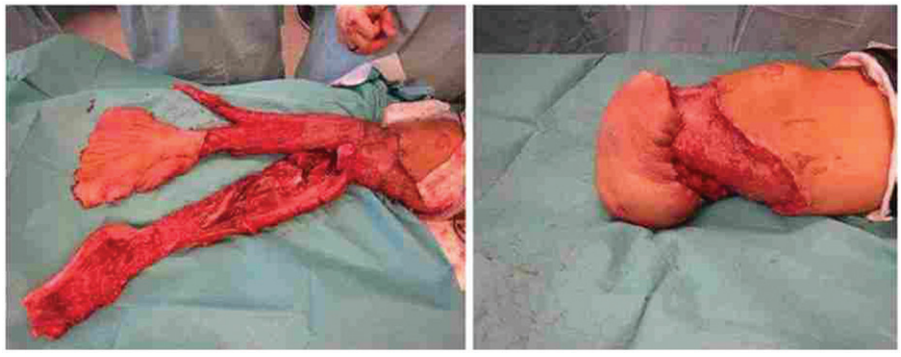

Figure 2. Pedicled fillet foot flap based on the tibial anterior vessels was harvested to close below-knee amputation stump on the right side.

The flap was raised with a 9-cm pedicle and connected end to side to the anterior tibial artery 5 cm from the proximal wound edge. The muscle was then covered with a split-thickness skin graft.

Eight weeks after the trauma, stable coverage was achieved and the patient started a physiotherapy program, including prosthesis fitting and was discharged from the hospital. Six months after surgery, the patient regained a stable, independent and painless gait. (Figures 4 and 5).

Figure 4. Photograph of the extremities at 6 months follow-up showing complete wound healing after performing a fillet foot flap in the right side and a free gracilis flap on the left side.

Discussion

The aim in the reconstruction of complex defects of the lower extremity is the restoration of the maximal function by providing stable wound closure, bone stability, plantar sensation and painless weight bearing. When facing high-energy traumatisms in both legs, as in the case that is presented, a strategical approach is necessary to optimize the functional outcomes. In that regards, spare-part surgery using a fillet foot flap has been described to be a valuable option to preserve the knee in cases of inadequate stump coverage in below-knee amputations. Fillet foot flaps have been used both as a pedicled or free flap with the goal of achieving a stable stump and length preservation by different authors as displayed in Table 1. As a free flap can be used in the acute setting when revascularization or replantation is not indicated as reported by Jupiter et al. [4]. When vascular supply to the foot is preserved, a pedicled fillet foot flap can be performed [5]. A pedicled fillet foot flap can be based on the posterior tibial neurovascular pedicle and/or the anterior tibial neurovascular pedicle, depending on the vascular patency, having the advantage of not requiring microsurgical anastomosis [6]. When available, the sole of the foot based on the posterior tibial neurovascular bundle is preferred to the dorsum of the foot since it carries plantar innervated skin that provides better sensation and prosthesis compliance, allowing better long-term stability and wound-free in pressure areas [7,8].

Figure 5. Preservation of the knee function allowed to have a satisfactory gait rehabilitation and prosthesis fitting.

Table 1. Literature review of fillet foot flaps in lower extremity reconstruction.

First author	Journal	Year	Number of fillet foot flaps	
			Pedicle	Free
J. B. Jupiter	Plast Reconstr Surg	1982	–	2
S. R. Colen	Clin Plast Surg	1983	–	1
R. C. Russel	Ann Plast Surg	1986	–	2
G. Gumley	Br J Plast Surg	1987	–	1
G. Gallico	Plast Reconstr Surg	1987	–	1
G. Frykman	Journal of Trauma	1987	–	1
W. E.Sanders	J Bone Joint Surg	1989	1	–
J. Katsaros	Br J Plast Surg	1991	2	–
G. G. Hallock	Ann Plast Surg	1991	1	–
J. J.Pribaz	Plast Reconstr Surg	1993	–	1
A. K. Kasabian	Plast Reconstr Surg	1995	–	6
Y. C. Chiang	Plast Reconstr Surg	1995	1	2
W. W.Shaw	Ann Plast Surg	1996	–	1
M. V. Küntscher	Plast Reconstr Surg	2001	12	–
S. Ghali	Plast Reconstr Surg	2005	6	–
M. S. Irwin	Plast Reconstr Surg	2006	–	1
M. Motomiya	Microsurgery	2011	1	–

In our case, due to extensive muscle necrotic, an amputation was indicated in the right lower leg, and reconstruction with a pedicled fillet foot was done to preserve the knee. Reconstruction of the left leg was delayed, and the wound was handled with VAC until the patient was able to receive a free flap, in accordance with the principles of damage control. As previously reported, VAC may allow to delay flap reconstruction beyond the frequently quoted critical interval, which yielded similar results to those of immediate reconstruction within the first three days, as reported in the literature [9].

In conclusion, a sequential use of a pedicled fillet foot flap along with a free flap for reconstruction of complex bilateral lower extremity soft tissue defects after high energy trauma is a valid alternative for achieving stable wound closure and maximizing length preservation which facilitates gait rehabilitation.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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