The distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flap for reconstruction of the distal third of lower leg

Ingo Schmidt

ABSTRACT

Introduction: The use of distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flap for coverage of the distal end of lower leg is recommended for soft tissue defects with exposure of bones and/or tendons in patients who are not willing or healthy enough to undergo free microvascular tissue transplantation, and do not require microsurgical expertise.

Case Series: A short presentation of six cases including a short review of literature will highlight current knowledge and complications of these procedures.

Conclusion: The distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flaps are useful for coverage of soft tissue defects of the distal third of lower leg. In our patients, the complication rate of distally pedicled neurofasciocutaneous sural artery flap is higher than the distally pedicled peroneus brevis muscle flap.

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Keywords: Distal third lower leg, Distally pedicled peroneus brevis muscle flap, Distally pedicled sural artery flap, Soft tissue defect

How to cite this article

Schmidt I. The distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flap for reconstruction of the distal third of lower leg. Int J Case Rep Images 2017;8(1):17–21.

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Received: 11 July 2016

Accepted: 10 October 2016

Published: 01 January 2017

Article ID: Z01201703CS10083IS

doi:10.5348/ijcri-201704-CS-10083

INTRODUCTION

Anatomical features of the distal third of lower leg and heel like subcutaneous bone surrounded by tendons with no muscles, vessels in isolated compartments with little intercommunication between them make the coverage of the wounds in the region a challenging problem. Options for coverage of soft tissue defects are free flaps, perforator flaps, reverse flow flaps, muscle flaps, cross leg flaps, and axial pedicled fasciocutaneous flaps such as the distally pedicled sural artery flap [1–3]. Quality debridement is the key to success for the healing of wounds in this region. Negative-pressure vacuum assisted closure (VAC) therapy before soft tissue coverage provides a sterile and controlled environment that can lessen the duration of wound healing, promotes better capillary circulation, and decreases the bacterial load [4]. The use of distally pedicled peroneus brevis muscle and neurofasciocutaneous sural artery flap for coverage of the distal end of lower leg is recommended for soft tissue defects with exposure of bones and/or tendons in patients who are not willing or healthy enough to undergo free microvascular tissue transplantation, and do not require microsurgical expertise.

CASE SERIES

Case 1

A 66-year-old female presented with chronically destroyed left Achilles tendon (Figure 1A) that was treated with an open augmented repair (Figure 1B). The patient developed early wound healing problems

resulting in a large necrotizing soft tissue defect (Figure 1C). The defect was covered with the use of a distally pedicled peroneus brevis muscle flap and additional split-thickness skin grafts (Figure 1D-E). The wound healing was uncomplicated (Figure 1F).

Case 2

A 67-year-old male presented with primary osteoarthritis of left ankle that was treated by total ankle arthroplasty, and resulting in soft tissue defect with exposure of anterior tibial tendon (Figure 2A). The tendon was covered with the use of a distally pedicled peroneus brevis muscle flap (Figure 2B) and additional split-thickness skin grafts. The wound healing was uncomplicated (Figure 2C).

Case 3

A 58-year-old male presented with a highly comminuted open intra-articular complete fracture of the right distal lower leg treated by external fixation

Figure 1: (A) Magnetic resonance image demonstrating chronically destroyed Achilles tendon (arrow), (B) Clinical photographs showing open augmented repair of Achilles tendon intraoperatively, (C) Clinical photograph showing large necrotizing soft tissue defect postoperatively, (D) Clinical photograph demonstrating harvesting of distally pedicled peroneus brevis muscle flap intraoperatively, (E) Clinical photographs showing transposition of peroneus brevis muscle before and after skin grafting intraoperatively, and (F) Clinical photographs postoperatively showing uncomplicated wound healing with preserving of eversion and plantar flexion of foot.

and internal plating (Figure 3A). The resulting defect of medial malleolus was initially treated with VAC therapy (Figure 3B). After that, the defect was covered with the use of a distally pedicled sural flap (Figure 3C). The wound healing was uncomplicated (Figure 3D).

Case 4

A 61-year-old female presented with a posttraumatic soft tissue defect of the left heel that was successfully treated with the use of a distally pedicled sural flap, the pivot point was primarily closed (Figure 4A).

Figure 2: (A) Posteroanterior (PA) radiographs and clinical photograph showing pronounced osteoarthritis of ankle treated by total ankle arthroplasty, and postoperatively resulting in soft tissue defect with exposure of anterior tibial tendon, (B) Clinical photographs demonstrating harvesting and transposition of distally pedicled peroneus brevis muscle flap, note that both peroneal nerves were preserved (arrows), and (C) Clinical photograph postoperatively showing uncomplicated wound healing.

Figure 3: (A) Posteroanterior radiographs demonstrating highly comminuted open intra-articular complete fracture of the distal lower leg primarily treated by external fixation, and clinical photograph showing VAC therapy of pre-tibial soft tissue defect, (B) Clinical photographs showing harvesting and transposition of distally pedicled sural flap intraoperatively, and (C) Lateral radiograph demonstrating open reduction and internal fixation after complete an uncomplicated wound healing.

Case 5

A 74-year-old male presented with a chronic ulcer of the left heel that was treated with the use of a distally pedicled sural flap. The pivot point was primarily closed, resulting in flap loss due to venous congestion (Figure 4B).

Case 6

A 84-year-old female presented with an chronic ulcer of the right heel that was treated with the use of a distally pedicled sural flap in another hospital. The flap was failed (Figure 5A) due to selection of an unacceptable too short vascular pedicle (Figure 5B). The resulting defect was covered with skin grafts in the further course.

DISCUSSION

Originally, the peroneus brevis was a type II muscle flap according to the classification by Mathes and Nahai [5] with a dominant pedicle from the peroneal artery which is located proximally, and distal minor pedicles from the peroneal or tibial vessels, but it was reclassified as a type IV [6]. When harvesting the muscle with the proximal segmented pedicles, it can be used as flap for coverage of the middle third of lower leg. When harvesting the distal segmented pedicles which are found within six cm from the tip of lateral malleolus (approximately three fingerbreadths), it can be used in a distally pedicled manner for the distal third of lower leg. Lorenzetti et al. reported on a flap survival of 100% of 10 patients, and the ankle functionality and stability were maintained due to preservation of peroneus longus muscle [7]. The advantage is that the donor site can always be closed primarily and the flap is relatively reliable even in high-risk patients with a number of comorbidities, but care must be taken when using this flap in patients with peripheral arterial disease [8].

Figure 4: (A) Clinical photographs showing harvesting and transposition of distally pedicled sural flap for coverage of chronic ulcer of the heel, the pivot point was primarily closed and the donor site was primarily covered with a split-thickness skin graft, this flap survived, (B) Clinical photograph demonstrating venous congestion of a distally pedicled sural flap after coverage of the heel leading to complete flap loss.

Figure 5: (A) Clinical photograph demonstrating a result after excision of a failed distally pedicled sural flap due to selection of an unacceptable too short vascular pedicle, and (B) The same patient in a retrospective reconstruction: if the correct pivot point (arrow) had been applied coverage of existing heel defect would not have been possible (imitation of the required 180° turned manner in this special situation), the primary procedure was performed in another hospital.

The distally pedicled neurofasciocutaneous sural artery flap was first described by Masquelet et al. [2], it is a skin island flap which is retrograde supplied by at least three perforator vessels from the peroneal artery within approximately six cm from the tip of lateral malleolus. However, this flap is not free of any complications mostly based on venous congestion, and the weakness can be the pivot point. The flap's arterial inflow is robust and constant, but the venous congestion is susceptible, occurring in up to 21.4% of cases [9], and it is mostly detected if the flap was used in a 180° turned manner [10]. To prevent venous stasis intra- and early postoperatively, the pivot point of vascular pedicle including the short saphenous vein can be covered temporary with a skin substitute and covered secondary with a skin graft. Another options to prevent venous congestion are the flap's use in a two-stage manner, supercharged or superdrained manner, and/or intermittent short saphenous vein phlebotomy [10–13]. Schmidt et al. [14] reported on a survival rate of flap's use in an adipofascial manner with additional skin grafting in 87.5% of 104 cases. In cases in which the short saphenous vein cannot be found, the flap should not be utilized; and in older, high-risk, and critically multimorbid patients including peripheral arterial disease, a considerable necrosis rate of 36% of a total of 70 procedures was found by Baumeister et al. [15]. An unacceptable failure leading

to a loss of flap is when the vascular pedicle was elected too short and no sufficient arterial supply exists.

CONCLUSION

The distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flaps are useful for coverage of soft tissue defects of the distal third of lower leg. In our patients, the complication rate of distally pedicled neurofasciocutaneous sural artery flap is higher than the distally pedicled peroneus brevis muscle flap.

Acknowledgements

I would like to thank Henrik Eisner for his help in designing the figures.

Author Contributions

Ingo Schmidt – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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Article citation: Schmidt I. The distally pedicled peroneus brevis muscle and fasciocutaneous sural artery flap for reconstruction of the distal third of lower leg. Int J Case Rep Images 2017;8(1):17–21.

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