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Treatment of chronic osteomyelitis using the medial sural perforator flap

Gunwook Park, Hyoheon Kim*

Yeungnam University Medical Center, Daegu, Republic of Korea

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KEYWORDS
Medial sural;
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Summary *Purpose:* The successful treatment of chronic osteomyelitis requires radical debridement followed by the obliteration of anatomical defects. It presents one of the most difficult challenges in medicine. The reconstruction of these defects with local or free non-muscle flaps also enables good blood flow as per that observed in muscle flaps. This is known as an alternative approach for treating chronic osteomyelitis.
Methods: Between April 2003 and February 2008, the authors operated on 18 patients suffering from chronic osteomyelitis over a 6-week period. The coverage of anatomical dead spaces with medial sural perforator free flaps was performed after debridement, primarily on those areas that required thin vascularised flaps such as the pretibia, the ankle, the dorsum of the hand and the scalp.
Results: Fourteen of 18 clinical cases with anatomical defects after radical debridement were successfully treated with the use of a medial sural perforator free flap. Partial or total necrosis of the flap was identified in four cases. In all of these four cases, with a single exception, the causes were identified as uncontrolled diabetes and underlying vascular insufficiency. They were successfully resurfaced with a local flap, skin graft for coverage of small skin defects without a recurrence of chronic osteomyelitis.
Conclusion: The medial sural perforator free flap is superior to other muscular free flaps in the reconstruction of thin areas, because it is adequately vascularised and does not require debulking procedures. It is anticipated that the medial sural perforator free flap will be more actively applied in the treatment of chronic osteomyelitis.

The incidence of bone- or tendon-exposed open wounds is increasing due to rising rates of industrial disasters and traffic accidents. In many cases, the proper point of treatment is missed, and therefore, chronic wounds with prolonged bone or tendon exposure develop, eventually leading to chronic osteomyelitis. Chronic

* Corresponding author. Address: Department of Plastic and Reconstructive Surgery, Yeungnam University Medical Center, #317-1 Daemyung-dong, Nam-gu, Daegu, Republic of Korea. Tel.: +82 53 620 3483; fax: +82 53 626 0705.
E-mail address: khhps@yumail.ac.kr (H. Kim).

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osteomyelitis is defined as a disease in which bone infection is apparently observed for over 6 weeks, caused by the spread of several infectious factors. It is reported that chronic osteomyelitis is very difficult to treat, and it requires positive surgical procedures because it is associated with infection and ischaemic symptoms following severe tissue injury.

The surgical treatment of chronic osteomyelitis requires aggressive debridement of the involved bone structures and soft tissues, followed by definitive reconstruction using viable muscle or non-muscle flaps. The use of muscle flaps has obtained superior results when used to treat chronic osteomyelitis. We remain concerned, however, about some associated disadvantages such as donor-site morbidity, flap-bulk aesthetic problems and pus formation. Non-muscle flaps have also been used for the treatment of osteomyelitis and no statistically significant difference was observed in the incidence of the recurrence of osteomyelitis between muscle and fasciocutaneous flaps.[1–3] We also considered the use of medial sural perforator free flaps as fasciocutaneous flaps in the treatment of chronic osteomyelitis as they have obtained satisfactory aesthetic outcomes and account for the disadvantages of muscular flaps. Between April 2003 and June 2006, we reconstructed anatomical defects by means of a thin medial sural perforator free flap, after complete debridement, in 18 patients suffering from chronic osteomyelitis, following up until February 2008. The patients achieved good results with complete wound coverage and the reduced necessity for secondary debulking procedures.

Patients and methods

Patients

The subjects of this study were 18 patients with chronic osteomyelitis, who were treated using a medial sural perforator free flap in our hospital between April 2003 and June 2006 and following up until February 2008. They consisted of 16 male patients and two female patients (mean age: 45.1; age range: 16–68). The duration of chronic osteomyelitis from its onset to time when the patient underwent surgery ranged from 1.2 to 120 months (average 21.5 months). The regions where chronic osteomyelitis developed included the pretibia in five patients, the ankle in three, the foot in eight, the dorsum of the hand in one and the scalp in another. Eleven of the 18 patients had some risk factors, such as diabetes, hypertension, vascular disease and a smoking history, against perforator free flap surgery. As a result of wound culture prior to the surgery, the following organisms were cultured: methicillin-resistant *Staphylococcus aureus* or *Pseudomonas aeroginosa*. Broad-spectrum antibiotics were used before culture results. Then, based on culture result, pathogen-specific intravenous antibiotic therapy was conducted, and the patients' vascular condition was examined via three-dimensional angio-CT and angiography prior to the surgery. Following complete debridement, a medial sural perforator free flap surgery was applied to reconstruct the anatomical dead space (Table 1).

Surgical procedures

Wound culture-based microbiological examination was preoperatively performed, followed by intravenous administration of the appropriate antibiotics over 2–6 weeks before the surgery for the purpose of reducing bacterial counts. Based on a previous study,[4] a virtual line was drawn from the centre of the popliteal fossa to the medial malleolus, and a 2-cm-radius semicircle was drawn distally from an 8-cm-distance point on a virtual line, and then the medial sural perforator was screened by Doppler scanning. Lower leg angio-CT and angiograms were carried out to check for appropriate preoperative vascular flow.

For the detailed operative procedure, all 18 patients were administered general anaesthesia and were placed in the supine position during the surgery. First, wide debridement of the infected bone and its adjacent soft and cutaneous tissues, where the chronic osteomyelitis had developed, was performed. Then, the debrided tissues were completely removed, and the appropriate recipient-area vascular pedicle was dissected. In addition, for some cases that had an internal-fixation device, all the fixation devices and screws were removed and replaced with an external-fixation device. After placing a tourniquet on the upper femoral region of the lower leg where the flap was to be harvested, the donor-site hip joint was abducted, and this was followed by bending the knee at a 90° angle. On considering the location of the vascular pedicle that was required for the defect location and size, the flap was designed along with the perforator, and after an incision was made along the lateral boundary of the chosen plane, deliberate dissection was performed, followed by identification of the perforators. The intramuscular dissection was performed so that an appropriately long vascular pedicle was obtained. In the cases with a wide defect in the soft tissue, some of the muscle was elevated with the flap. The elevated flap was 3 or 5 mm thick, and it was microscopically anastomosed with the recipient-area vascular pedicle under a microscope. On confirmation that there was neither twisting of the vascular pedicle nor kinking and that the blood flowed appropriately in the connected vascular pedicle, the flap was fixed in the recipient area. For those patients with a relatively small defective area, most of them underwent primary closure of the flap-elevated region, while the patient with a large defective area underwent partial primary closure followed by skin grafting for the remaining defect.

Case reports

Case 1

A 43-year-old man was admitted to our department with an open fracture of the left malleolus and tibiofibular open fractures. The chronic wound size was $9.5 \times 5\ cm^2$, and it manifested with multiple debris and exposed bone, persisting for 1.5 months. Microbacterial infection was found, including methicillin-resistant *Staphylococcus aureus*, and this required intravenous administration of vancomycin for several weeks. After extensive debridement of the infected bone and its adjacent soft tissue, a medial sural perforator free flap that included one patent perforator and a 10-cm-long vascular pedicle was elevated.