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Case Reports and Series

An Innovative Application of the Free Vascularized Medial Femoral Condyle Flap in the Prevention of Recurring Neuropathic Ulcer in the Diabetic Foot: A Case Report

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ABSTRACT

Despite various therapy options, the prophylactic and symptomatic treatment of recurrent ulcerations in the diabetic foot are still challenging. We report the application of a free vascularized medial femoral condyle flap to prevent the recurrence of pressure ulcer in a patient with diabetic foot syndrome. Our patient had type 2 diabetes and presented with pressure ulcers and osteomyelitis of metatarsal heads 2 and 3 after a great toe amputation. We chose to use a medial femoral condyle flap as a damper in the area of the metatarsal heads because of the relatively young age and good vascularity of our patient. We shaped the graft like a ski to distribute the pressure and prevent perforation of the plantar skin. Good results were achieved for wound healing, pain reduction, and improvement of gait. No pressure ulceration had recurred after a 3-year follow-up period. The versatility of the osteomyocutaneous graft from the medial femoral condyle is an important reconstructive tool for addressing major surgical problems. We present the first use of a medial femoral condyle flap in the treatment of a pressure ulcer in a diabetic foot. In selected patients, our method could prevent premature and extended amputations, thereby providing good improvement in patients' quality of life.

Amputations in diabetic foot are associated with an increased risk of developing a recurrent ulcer to the distal aspect of the foot (1,2). This mechanism can be induced by changes in the pressure distribution after amputation, aggravated by the underlying disease (2,3). Patients with a first ray amputation have significantly greater peak pressures under their metatarsal heads and toes compared with the contralateral side (3). Ulceration increases the risk of infection and osteomyelitis and can lead to progressive tissue destruction (4). Although various therapy options for diabetic foot have been described previously (5–7), the prophylactic and symptomatic treatment of recurrent ulcerations are still challenging in terms of the reamputation rate (8–10).

Inspired by ski airplanes, we developed the idea of preventing the recurrence of ulcerations by distributing the pressure under the metatarsal heads over a larger contact area using a medial femoral condyle (MFC) flap. In 1991, Sakai et al (11) first described a technique using this graft as a free corticoperiosteal flap for fracture nonunion of the upper extremity. Since then, the graft has seen success in various parts of the body such as the treatment of recalcitrant fracture nonunion (12–15), osteomyelitis (15,16), avascular necrosis (13), arthritis (13), osteoradionecrosis (17), and for tendon repair and reconstructive cartilage transplantation (18). The graft includes the descending genicular artery (DGA), a branch of the superficial femoral artery, and the superomedial genicular artery arising from the popliteal artery (14,19). The DGA can divide into several branches, allowing for the inclusion of a muscle segment and/or skin paddle for the graft. Descending from the DGA, the articular branches end in the medial epicondyle, and the muscle branches supplying the vastus medialis and the saphenous artery (14,20,21) separate further into the cutaneous branches (21) supplying the overlying skin.

We report a case with a promising innovative application for the MFC flap using it as a damper to prevent the recurrence of neuropathic pressure ulcers in the diabetic foot.

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Case Report

A 49-year-old male patient had undergone traumatic amputation of the first ray of the right foot in 2009. During the initial treatment at an external hospital, type 2 diabetes was first diagnosed. After a period of several months, the patient developed pressure ulcers in the metatarsal heads 2 and 3, which were treated conservatively by the diabetic foot outpatient clinic of our hospital. First-line therapy (22) was performed by offloading with a total contact cast. In addition, adequate antidiabetic therapy and consequent wound management were initiated. However, the local status worsened, and the wound became infected. Antibiotic treatment was performed using a combination of 2 antibiotics (ampicillin/sulbactam and ciprofloxacin). Magnetic resonance imaging –angiography showed no relevant stenosis in the lower extremities. However, osteomyelitis in the metatarsal head 2 and 3 was suspected. After a 2-year period, conservative treatment showed no improvement in local status (Figs. 1 and 2). In August 2013, the patient presented to our outpatient clinic with the diagnosis of a diabetic foot with polyneuropathy but without macroangiopathy. No evidence was found of a Charcot foot or angle equinus. Due to the therapy-resistant osteomyelitis of metatarsal heads 2 and 3, resection was indicated. Because of our patient's relatively young age and good vascular status, we decided to perform a microvascular construction to distribute the pressure in the plantar area. A free vascularized medial femoral condyle flap was regarded as the best solution. Surgery was performed in November 2013 with the patient under general anesthesia. The patient was placed in the supine position, and a tourniquet was applied on the right thigh. After resection of metatarsal heads 2 and 3 (Fig. 3), a wax replica was made to define the actual size of the MFC flap needed. The 8 × 2 × 2.5-cm osteomyocutaneous flap was then raised from the right knee (Fig. 4).

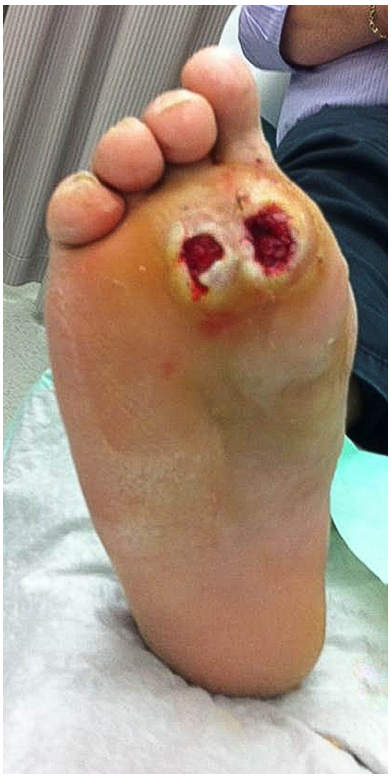

Fig. 1. Preoperative view showing the patient seen in our outpatient clinic after unsuccessful conservative treatment with ulcerations in the area under the metatarsal heads.

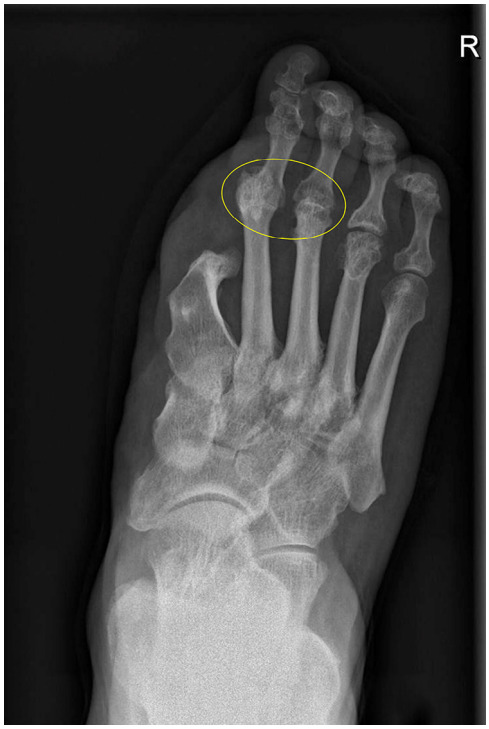

Fig. 2. Preoperative radiographic dorsoplantar view showing the right foot with severe destruction in the area under metatarsal heads 2 and 3 after first ray amputation.

We used 2.0- and 2.4-mm screws and Kirschner wire to perform fixation of the metatarsal bones (Fig. 5). The vessels of the articular branch of the DGA were anastomosed to the dorsalis pedis vessels. For 1 week, only dressings were used to support wound healing. A split below-the-knee cast was kept in place for 2 weeks until suture removal. A total contact below-the-knee cast was then applied for another 12 weeks. A rehabilitation program was initiated, beginning with partial weightbearing (15 kilos) at 12 weeks postoperatively, followed by full weightbearing from the 16th week after surgery. At a follow-up appointment 7 months postoperatively, satisfactory wound healing had occurred, with no recurrence of any ulceration (Fig. 6). At the patient's request, thinning of the flap was performed at 2 years postoperatively for cosmetic purposes and comfort. During the procedure, we were able to examine the ossification process, which revealed satisfactory bone healing. In June 2016, ~3 years after the surgery, the patient was satisfied without any pain and could walk with orthopedic shoes, showing satisfactory walking function.

Discussion

For diabetic patients, the lifetime risk of developing foot ulcerations is ~25% (23). Diabetic foot ulcers have a major negative effect on a patient's quality of life, affecting both the psychosocial aspect and their physical functioning (24). Despite the various treatment options—as described—pressure ulcerations developing after amputation can lead to repeat amputation. An amputation places a significant burden on the patient and is not a suitable method for young and physically active individuals. In the present patient, we used the MFC flap as an innovative option in the treatment of a neuropathic pressure ulcer in a diabetic foot.

The development of the diabetic foot in the present patient resulted mainly from 2 factors. First, traumatic amputation of the first ray led to an unnatural pressure distribution on the plantar aspect of