

## Square, Random Fasciocutaneous Plantar Flaps for Treating Noninfected Diabetic Plantar Ulcers: A Patient Series



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### ARTICLE INFO

Level of Clinical Evidence: 4

#### Keywords:

diabetic foot  
fasciocutaneous flap  
neuroischemic ulcer  
neuropathic ulcer  
total contact cast

### ABSTRACT

In patients with diabetes, the off-loading cast has not been widely used to treat plantar ulcers because of its poor acceptance by patients and the high risk of side effects. We evaluated the safety and efficacy of an alternative surgical treatment: a square, fasciocutaneous random plantar flap to cover plantar ulcers. From December 2012 to February 2013, we enrolled 23 consecutive diabetic patients with deep neuropathic or neuroischemic plantar ulcers. Of these 23 patients, 9 underwent percutaneous transluminal angioplasty, 10 had the metatarsal removed, 3 underwent dorsiflexory, distal metatarsal osteotomies, 2 underwent first metatarsophalangeal joint resection and ray stabilization with Kirschner wires, and 1 each underwent midfoot exostectomy, sesamoidectomy, and partial calcaneotomy. A square random fasciocutaneous plantar flap was created for all 23 patients. Two patients were excluded from the analysis for weightbearing on the involved foot within 24 hours of surgery. The healing rate was 100% for the remaining 21 patients, with healing by first intention in 15 (mean  $\pm$  standard deviation time to healing  $30 \pm 13$  days), by second intention in 5 ( $86 \pm 40$  days), and by surgical revision in 1. The overall mean healing time was  $44 \pm 31$  days. During a mean follow-up of  $724 \pm 275$  days, no ulcer recurred; however, 1 transfer ulcer appeared on an adjacent metatarsal head. The use of a square random fasciocutaneous plantar flap is a safe and effective surgical option for treating neuropathic plantar ulcers, offering a high healing rate, a short healing time, and a low rate of recurrence.

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Plantar ulcer, a principal complication of diabetic polyneuropathy (1), will develop in nearly 60% of diabetic patients after 20 years of disease (2). The overall incidence is 2% to 3% annually, and the overall prevalence is 4% to 10% (3). Ulcers carry a high risk of infection and major amputation (4). In nearly 50% of patients, peripheral arterial disease, with different degrees of impaired tissue perfusion, can result in polyneuropathy, leading to severe impairment of ulcer healing (5,6).

Joint rigidity, together with foot insensitivity to pain, causes an insensitive callus that can evolve into a perforating plantar ulceration that exposes the deep structures of the foot, including the muscles, tendons, and bone. Off-loading pressure from the ulcer has been

suggested as the treatment of choice for these lesions (7). In the past 10 years, many physicians have preferred the fiberglass nonremovable total contact cast (TCC) to treat neuropathic plantar ulcers or neuroischemic plantar ulcers in patients with a transcutaneous oxygen tension (TcPO<sub>2</sub>) of  $\geq 30$  mm Hg (8). The plaster TCC has not been widely used because of its rigidity, weight, and high incidence of ulceration. The fiberglass nonremovable and the removable off-loading cast and boot can be as effective as plaster casts and have fewer side effects, but only for grade 1 and 2 forefoot wounds in the Texas University Wound Classification (9–11).

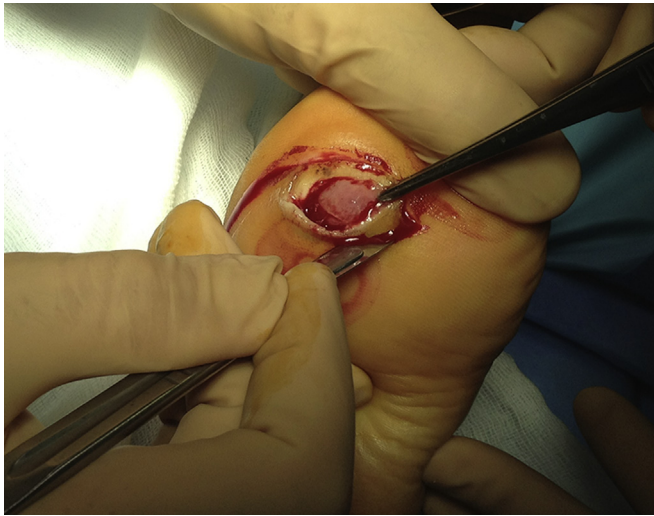
In 2008, the International Diabetic Foot Working Group published a consensus document indicating that the nonremovable off-loading cast is the treatment of choice for neuropathic and neuroischemic plantar ulcers in patients with a TcPO<sub>2</sub> of  $\geq 30$  mm Hg (12). Despite this strong endorsement, the TCC has not been widely adopted because of its poor acceptance by patients, the high cost of the materials, and the difficulties in making the cast.

**Financial Disclosure:** None reported.

**Conflict of Interest:** None reported.

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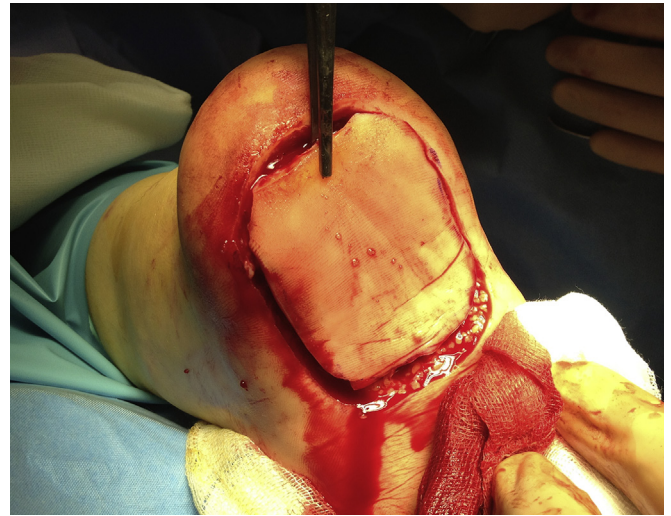
E-mail address: caravaggi@me.com (C.M.F. Caravaggi).



**Fig. 1.** The right foot of 56-year-old male with a noninfected diabetic plantar ulcer with bone exposure.

In 2002, Blume et al (13) proposed an alternative to the TCC; namely, a single-step surgical procedure for treating neuropathic plantar ulcers. In 67 diabetic patients with plantar ulcers in different areas foot, they created a local random plantar flap to cover the ulcer. In these patients, the median  $\pm$  standard deviation (SD) healing time was  $30.8 \pm 40$  days, and the median healing rate was 97%, indicating that the surgical approach to neuropathic plantar ulcer treatment can be safe and effective.

Considering the limited use and popularity of the TCC and the surgical results from Blume et al (13), we conducted a single-center observational study to evaluate the safety and efficacy of a square,



**Fig. 3.** The heel ulcer was covered with a squared fasciocutaneous random plantar flap.

local, random fasciocutaneous flap in treating neuropathic and neuroischemic plantar ulcers.

## Materials and Methods

### Patient Selection

From December 2012 to February 2013, we enrolled consecutive patients with grade 2 or 3 Texas University Wound Classification, uninfected, neuropathic, or neuroischemic plantar ulcers treated with a local random fasciocutaneous plantar flap. We excluded patients



**Fig. 2.** Ulcerectomy in the heel of the right foot of 49-year-old male with a noninfected diabetic plantar ulcer.



**Fig. 4.** Squared fasciocutaneous random plantar flap after suture on heel area.

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