SCIENTIFIC ARTICLE

Foot Web Free Flaps for Single-Stage Reconstruction of Hand Webs

Francisco del Piñal, MD, PhD, Melissa Klausmeyer, MD, Eduardo Moraleda, MD, Guillermo H. de Piero, MD, Jaime S. Rúas, MD, Maciej Klich, MD

Purpose To present a method for reconstructing the digital web in posttraumatic defects using a free tissue transfer of the web from the foot and to present the functional and aesthetic results.

Methods Nine web free flaps were performed; 8 were used to reconstruct posttraumatic web losses and 1 was used to reconstruct a defect resulting from to infection. All cases involved the first (3) or second (6) webs of the hand. Web flaps were taken from the foot first web (2 patients), from the second (6 cases), and from the third (1 case) in a patient with congenital syndactyly of second foot web space. The donor site was managed by skin grafting from the instep (1 case), creation of a syndactyly (7 cases), or both (1 case).

Results All flaps survived without complications. Finger abduction and flexion-extension were similar to the contralateral side. No functional limitations, pain, or contracture were reported. One donor site healed with hypertrophic scars; otherwise, no donor site complications occurred. On a visual analog scale (0−10), the patient assessed appearance of the hand and the donor foot as 9.0 and 9.0, respectively, on average. One web was not well-positioned in the first operation and required revision.

Conclusions The foot web free flap reconstructs the hand web by replacing it with a similar functional subunit rather than attempting to recreate the complex geometry, and allows for full function and excellent appearance of the hand. *(J Hand Surg Am. 2015;40(6):1152−1160.*

Type of study/level of evidence Therapeutic IV.

Key words Microsurgery, free flap, web reconstruction, crush, web flap.

Web space defects pose a reconstructive challenge because of the anatomic and functional characteristics of the specialized tissue. From a functional standpoint, the web is critical for independent flexion, extension, and abduction of the digits.[1]

From Instituto de Cirugía Plástica y de la Mano, Private Practice and Hospital Mutua Montañesa, Santander, Spain.

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Corresponding author: Francisco del Piñal, MD, PhD, Instituto de Cirugía Plástica y de la Mano, Private Practice and Hospital Mutua Montañesa, Paseo de Pereda 20-1, E-39004 Santander, Spain; e-mail: drpinal@drpinal.com, pacopinal@gmail.com.

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From an anatomical standpoint, the second through fourth webs slant in a proximal-dorsal to distal-palmar direction at a 45° angle extending from the metacarpal head to the midlevel of the proximal phalanx. The skin of the web itself is rectangular and the volar aspect has glabrous skin.[2] The anatomy of the first web is difficult to define; most efforts have been directed to defining the maximal abduction[3] and little has been reported on its shape.[4] Each web consists of skin that is thin and pliable enough to allow full abduction of the fingers without bulging in adduction.

Much of the literature describing web reconstruction addresses the management of congenital syndactyly and burns.[5−9] In syndactyly, local tissues are often available. In the case of severe burns, the fat underlying the contracted area is healthy and

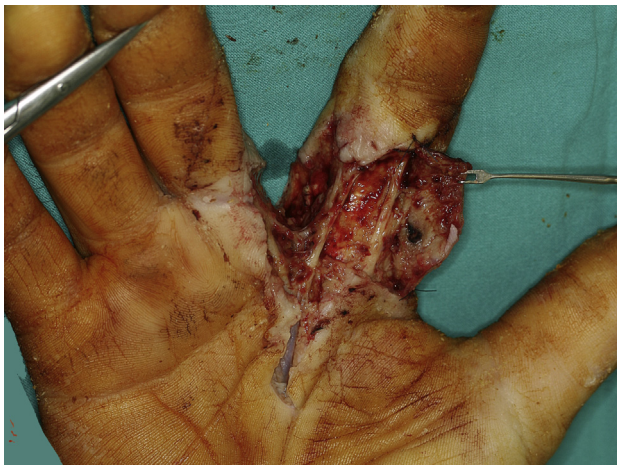

FIGURE 1: Typical complex web defect of this series. Clinical picture after the third debridement (first performed by the authors) after a high-pressure injection injury. Note the exposed digital vessels within the wound bed and the loss the subcutaneous fat (patient 2).

full-thickness grafts may be used.[10–12] However, for large defects with exposed bone or exposed tendons devoid of paratenon, neither local flaps nor skin grafts are an option (Fig. 1). In those cases, regional flaps or free flaps may be an alternative, particularly for reconstruction of the first web.[13–20] However, in many of these reconstructions, the functional and cosmetic results are far from ideal because the flaps are thick and minimally pliable compared with the native web.

The purpose of this study was to present our technique and report our results of restoring the hand web in a single stage by transferring a free foot web flap.

MATERIALS AND METHODS

Between 2006 and 2014, 9 patients (4 male and 5 female) underwent web space reconstruction with this technique. Patients' ages range 14 to 68 years (average, 38 y). Causes of the defects varied. Four patients underwent reconstruction for acute injuries and 5 for chronic injuries. Before referral, 3 patients received treatment for web contracture release: 1 skin graft, 1 reverse radial forearm flap, and 1 intermetacarpal flap (Table 1).

The second web was transferred in 6 cases (including 2 cases of first web reconstruction) and the first web in 2 (1 for the first web and 1 for the second). The third web was transferred once, in a patient who had congenital syndactyly of the second foot web.

Our institution does not require institutional review board approval; however, all patients were aware of the treatment aims, understood the risks and possible benefits, and were aware of other reconstructive alternatives.

Patients were called back for the purpose of this study 6 months to 8 years after the transfer and were assessed. Specifically, they were asked to report any limitation of the web such as subjective feeling of tightness, pain, or functional limitation. In patients in whom the first web was reconstructed, the web angle in maximum abduction was measured.[3] For patients with chronic wounds, the Patient-Rated Wrist–Hand Evaluation score was administered preoperatively and postoperatively. Patients were asked to rate their satisfaction with the appearance of the web of the hand and the donor site on a visual analog scale (0 = worst to 10 = best). To assess the impact on the foot, we also administered the American Orthopaedic Foot and Ankle Society questionnaire for lesser toes.

Surgical technique

Each patient underwent a single-stage reconstruction. No preoperative vascular study was performed for the hand or the foot. Except for donor site closure, the first author performed the procedure. First, the hand was prepared and debrided as appropriate. Then, the defect measurements were transposed to the foot web. Precision in the measurements was important to define whether the defect was of the entire web or was predominantly central, palmar, or dorsal (Fig. 2). Elevation of the first foot web flap has been previously described.[21]

We dissected the second or third web under tourniquet control and with gravity exsanguination only. The web flap was incised dorsally and a dorsal subcutaneous vein was identified and isolated. In most cases, a short length of vein was sufficient to anastomose to one of a number of dorsal veins available in the hand. The flap dissection continued to the periosteum and the flap was dissected off of the metatarsals, metatarsophalangeal joints, and proximal phalanx subperiosteally. In the proximal aspect of the web, the dominant artery was identified and its side branches were ligated. A plantar artery was preferred to reconstruct the second through fourth hand webs to anastomose to the available recipient palmar arteries more easily. For the first web, however, a dorsal metatarsal artery was preferred to reach a dorsal branch of the radial artery. Similar to the first web anatomy,[21] variations of the second web space arteries exist[22] and were anticipated at the time of dissection. A pedicle of 3 to 5 cm of a dorsal artery (eg, second dorsal metatarsal artery) was easily obtained. When plantar system was used, the maximum pedicle length was 1.5 to 2 cm. The pedicle could be further dissected