Injury, Int. J. Care Injured 45 (2014) 2013–2017

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Direct and reversed dorsal digital island flaps: A review of 65 cases

Chao Chen [a,1], Peifu Tang [a,2], Gang Zhao [b,*]

[a] The Department of Orthopedics, Chinese PLA General Hospital, Beijing 100853, PR China
[b] Hand Surgery Department, The Second Hospital of Tangshan, Tangshan 063000, Hebei, PR China

ARTICLE INFO

Article history:
Received 21 May 2014
Received in revised form 6 August 2014
Accepted 11 August 2014

Keywords:
Soft tissue defect
Dorsal branch of the digital nerve
Dorsal branch of the digital artery
Dorsal digital island flap

ABSTRACT

Background: Reconstruction of soft tissue defects in fingers continues to be a challenging problem. The purpose of this study is to report the reconstruction of small-to-moderate defects of fingers with dorsal digital island flap (DDIF) and to evaluate the efficacy of use of the flap.

Methods: Over last six years, a retrospective study was conducted with 65 patients who had soft tissue defects of fingers treated with the DDIF. Sixty-nine soft-tissue defects were found in 69 fingers in 65 patients. Based on the flow direction of blood supply, the patients were divided into two groups: the direct ($n = 35$) and reversed ($n = 30$) DDIF groups. In addition, based on the different donor sites, the direct DDIF group was divided into two subgroups: the proximal phalangeal direct DDIF subgroup ($n = 16$) and the extended pedicle direct DDIF subgroup ($n = 19$). The main outcomes were static 2-point discrimination and Semmes–Weinstein monofilament scores of flap and joint motion.

Results: At the final follow-up, the mean static two-point discrimination of the flaps was 9.7 mm (range, 8 to 12 mm) in the proximal phalangeal direct DDIF subgroup and 8.3 mm (range, 7 to 11 mm) in the extended pedicle direct DDIF subgroup, with a significant difference ($p = 0.005$). In the direct DDIF group, there was no significant difference in total active motion between the donor fingers and the opposite sides. In the reversed DDIF group, the mean total active motion of the donor fingers was 170° and the data of the opposite sides was 181°, with a significant difference ($p = 0.024$). Maximum amplitude losses of 15° were seen in 12% of patients in the distal interphalangeal joint.

Conclusions: The DDIF is reliable and technically easy for reconstructing small-to-moderate defects of fingers. The extended pedicle direct DDIF may be an optional solution when sensory reconstruction is needed.

Introduction

Reconstruction of soft tissue defects in fingers continues to be a challenging problem. Appropriate therapy should use local tissue whenever possible, preserve the aesthetic appearance, provide sensate coverage in important anatomical regions, and minimise donor-site deformities [1]. According to these principles, the dorsal digital island flap (DDIF) may be an alternative for reconstructing small-to-moderate defects of the fingers.

As described in previous anatomical studies, the dorsal branches of the digital artery presented an orderliness and consistency of distribution and location. A study by Braga-Silva et al. [2] confirmed the existence of continuous vascular networks between the dorsal branches, which constitute the vascular system over the dorsum of a finger. At the proximal phalanx, the dorsal digital arteries stemmed from the dorsal metacarpal arteries anastomose with the vascular system (Fig. 1 left) [3]. Zhang et al. [4] demonstrated that the dorsal branch of digital nerve was present in all the fingers. The nerve branch is supplied by the small accompanying arteries, which also anastomoses with the dorsal vascular networks (Fig. 2 left). These anatomical structures are the basis for the use of the direct and reversed DDIFs.

The direct DDIF is a sensate flap, which receives its blood supply from the dorsal digital artery stemmed from the dorsal metacarpal artery through the dorsal vascular networks [5,6]. However, the limited length of the pedicle precludes its use for the defects distal to the proximal interphalangeal joint (Fig. 1 right). To extend the reach of the anterograde flap, we modified this technique to harvest the dorsal branch of the digital nerve with the pedicle (Fig. 2 right) [7]. In this manner, the flap based on the accompanying arteries of this nerve branch can easily reach a

* Corresponding author. Tel.: +86 13717517534.
E-mail addresses: ts_chenchao@163.com (C. Chen), tangpeifubeijing@163.com (P. Tang), ts_13717517534@126.com (G. Zhao).
[1] Tel.: +86 13700350471.
[2] Tel.: +86 13801379901.

http://dx.doi.org/10.1016/j.injury.2014.08.030
0020–1383/

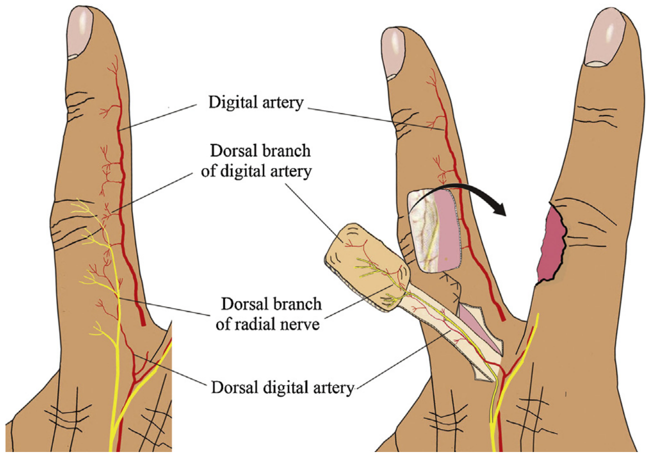

Fig. 1. The dorsal branches of the radial nerve innervate the dorsal skin of the proximal phalanx and proximal interphalangeal joint (*Left*). The proximal phalangeal direct DDIF receives its blood supply from the dorsal digital artery through the dorsal vascular networks. The dorsal branch of the radial nerve is included in the flap (*Right*).

defect as far as the middle phalanx. The reversed DDIF, which can be taken from the proximal or middle phalanx, allows one to cover the defects from the distal half of the middle phalanx to the tip of the same finger (Fig. 3) [8]. Compared with the direct DDIF, the reliability of the reversed DDIF emphasises the importance of subcutaneous "random" circulation (Figs. 4–9).

The purpose of this retrospective study was to evaluate the efficacy of the direct and reversed DDIFs for the tissue reconstruction in different regions of a finger and to report our experience of a series of 65 patients treated with this technique.

Patients and methods

This study was approved by the Institutional Review Boards of the participating hospitals. Informed consent and Health Insurance Portability and Accountability Act consent were obtained from each patient.

A retrospective study was conducted, which included 65 patients treated with the DDIF from 2007 to 2013. The patients included in the study were selected from all 79 patients who had

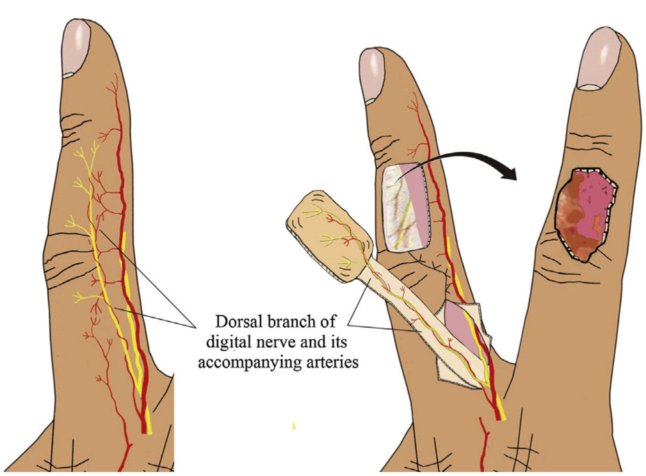

Fig. 2. The dorsum of the middle phalanx is supplied by the dorsal branch of the digital nerve (*Left*). The extended pedicle direct DDIF receives its blood supply from the small arteries around the nerve branch and is harvested from the middle phalanx of adjacent finger (*Right*).

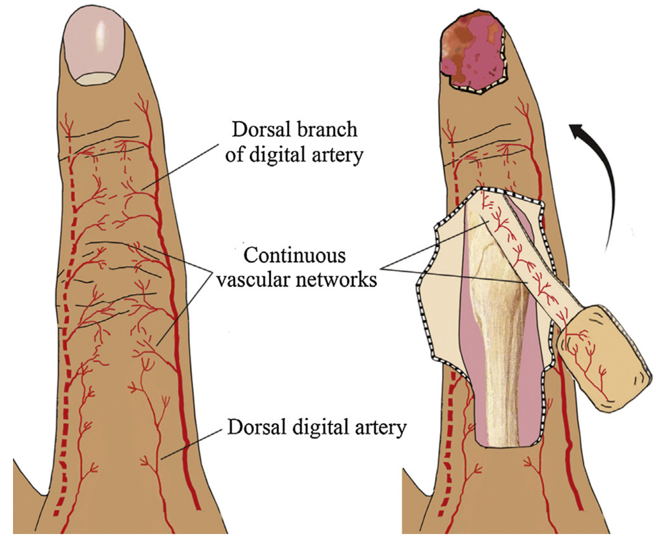

Fig. 3. Continuous dorsal vascular networks between the dorsal branches of the digital artery and the dorsal digital arteries stemmed from the dorsal metacarpal arteries (*Left*). The reversed DDIF receives its blood supply from the vascular networks and is harvested from the proximal phalanx of the same finger (*Right*).

tissues reconstructed with the DDIF at our hand surgery centre. Of these, 11 patients were lost to follow up, and 3 patients with a follow-up period of less than 16 months were excluded from the study. The patients remaining in the study included 54 male and 11 female patients with an average age of 32 years (range, 17 to 58 years). The causes of the defects were sharp cut ($n = 7$), avulsion ($n = 36$) and crush ($n = 22$). There were 69 soft-tissue defects in 69 fingers in 65 patients. Single-finger defects were noted in 62 cases and multiple-finger defects were noted in 3 cases. The injured fingers included 21 index, 16 long, 14 ring, and 18 little fingers. In this series, the size of the defects ranged from 1.8 to 2.7 cm long (mean, 2.2 cm) and 1.6 to 2.2 cm wide (mean, 1.8 cm). Based on the flow direction of the blood supply, the patients were divided into two groups: the direct ($n = 35$) and reversed ($n = 30$) DDIF groups. Three patients with multiple finger defects on the distal phalanxes were treated with the reversed DDIFs, and included in the reversed DDIF group. In addition, based on different donor sites or different nerve branches included in the flap, the direct DDIF group was divided into two subgroups: the proximal phalangeal direct DDIF subgroup ($n = 16$) and the extended pedicle direct DDIF subgroup ($n = 19$). Emergency surgery was conducted

Fig. 4. A dorsal defect of the proximal phalanx of the index finger (*Left*). A proximal