

Reconstruction of a neurocutaneous defect of the proximal phalanx with a heterodigital arterialised nerve pedicle flap[☆]



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ABSTRACT

Background: Complex digital injuries involving soft-tissue loss and digital nerve defect pose a challenging problem for hand surgeons. The purpose of this study was to evaluate the efficacy of transferring the heterodigital arterialised nerve pedicle flap for reconstructing the digital neurocutaneous defects and to compare the results with those of transferring the cross-finger flap and secondary nerve grafting.

Methods: From March 2008 to September 2011, the nerve pedicle flap was used in 12 patients who had a combination of soft-tissue and digital nerve defects. The injured fingers included four index, four long, three ring and one little finger. The mean size of the soft-tissue losses was 2.4×1.9 cm (range, 2.3×1.3 to 3.2×2.0 cm). The mean flap size was 2.6×2.1 cm (range, 2.5×1.5 to 3.4×2.2 cm). The length of the nerve defects ranged from 1.5 to 3.8 cm (mean, 2.8 cm). The nerve defect was reconstructed with transfer of the digital nerve dorsal branch. For comparison, we collected a series of 24 patients with similar defects treated with the cross-finger flap and secondary free nerve grafting.

Results: Significant differences were found between the two groups in static two-point discrimination ($p < .01$) and pain ($p = .03$) in the reconstructed finger. In comparison, the study group presented better discriminatory sensation on the finger pulp and lower incidence of pain sensibility in the injured finger. There was no significant difference in cold intolerance and Semmes–Weinstein monofilament. In the study group, the total active motion of the donor fingers was similar to that of the opposite hands.

Conclusions: The heterodigital arterialised nerve pedicle flap is useful and reliable for reconstructing the neurocutaneous defects in the proximal phalanx. Comparable sensory recovery and lower pain incidence can be achieved using our nerve pedicle flap instead of conventional nerve grafting.

Type of study/level of evidence: Therapeutic II.

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Introduction

Injuries to the digital nerve affect the tactile perception of the finger pulp. Restoration of pulp sensibility to the traumatised finger is a difficult problem. When a digital nerve defect is complicated by an associated soft-tissue loss, the reconstructed alternatives are more limited [1]. In such a situation, the heterodigital arterialised nerve pedicle flap can be used as an alternative to resolve this problem.

As described in previous anatomical studies, the dorsal skin distal to the proximal interphalangeal joint, but not the nail bed, is innervated by the dorsal branches of the digital nerves [2]. This dorsal branch originates from the base of the proximal phalanx, runs obliquely and dorsally across the proximal phalanx and terminates at the ipsilateral dorsum of the middle phalanx (Fig. 1). The sensory branch has been used for restoring the neurosensory function of digits due to its similarity to the digital nerve in diameter [3–8].

In 2013, the authors reconstructed digital nerve defects with local nerve transfer from the dorsal branch of the uninjured digital nerve [9]. In 17 patients, we achieved a mean static two-point discrimination (2PD) of 6.4 mm in the finger pulp. The heterodigital arterialised flap is a useful technique for tissue reconstruction of digits [10]. The artery of the flap is the digital artery and the venous drainage is through a dominant dorsal vein. Unlike the Littler flap [11], the digital nerve is left *in situ*, thus avoiding venous

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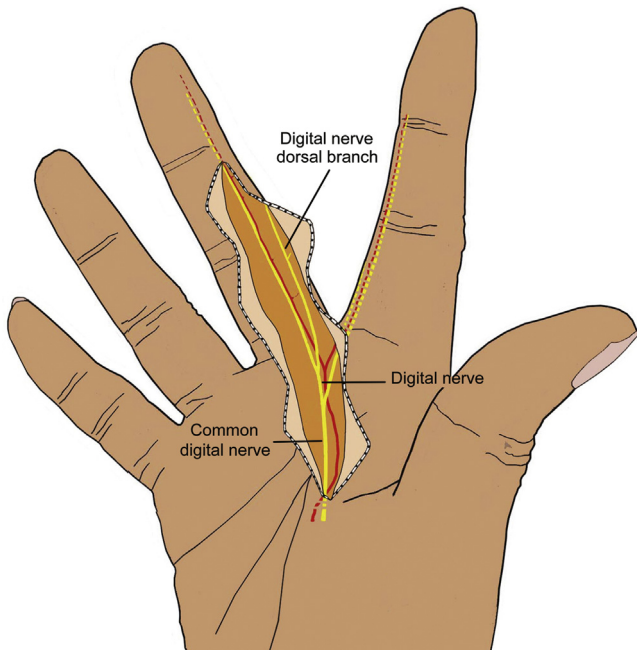


Fig. 1. The dorsal branch of the digital nerve is originated from the digital nerve where digital vascular bifurcation usually occurred. It crosses the digital vascular bundle posteriorly and terminates at the dorsum of the middle phalanx.

congestion and neurologic complications resulting from the Littler flap. Based on the two techniques, we combined the nerve branch with the heterodigital arterialised flap for reconstructing a combination of soft-tissue and nerve defects of the finger (Figs. 2 and 3).

The purpose of this retrospective study was to evaluate the efficacy of transferring the heterodigital arterialised nerve pedicle flap for reconstructing the digital neurocutaneous defects and to

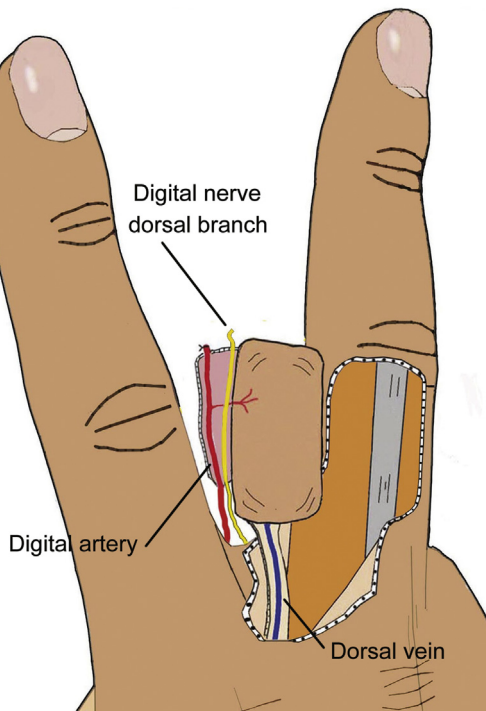


Fig. 2. The mother artery of the flap is a digital artery and the venous drainage is through a dorsal vein. The digital nerve dorsal branch is included in the vascular pedicle.

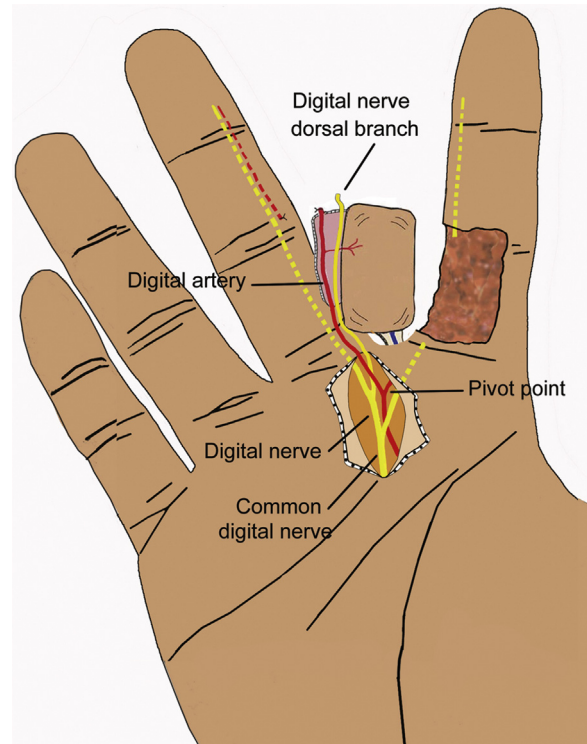


Fig. 3. The pivot point of the flap is located at the bifurcation of the common digital artery.

compare the results with a series of 24 patients treated with the cross-finger flap and secondary nerve grafting.

Materials and methods

A retrospective study was conducted with 12 patients who had a neurocutaneous defect in the proximal phalanx treated with the heterodigital arterialised nerve pedicle flap from March 2008 to September 2011. The study included nine men and three women, ranging in age from 24 to 46 years (mean, 33 years) (Table 1). The injured digits included four index, four long, three ring and one little finger. The mechanisms of injury were avulsion ($n = 5$) and crush ($n = 7$). In the series, the mean size of the soft-tissue defects was 2.4×1.9 cm (range, 2.3×1.3 to 3.2×2.0 cm); the mean size of the flaps was 2.6×2.1 cm (range, 2.5×1.5 to 3.4×2.2 cm). The length of the nerve defects ranged from 1.5 to 3.8 cm (mean, 2.8 cm). The surgical procedures were emergently conducted in nine patients, whereas the procedures were performed within 4 weeks after the primary surgeries in three cases. The mean surgical time was 2.6 h (range, 2.2–3.5 h).

The patients in this study needed to meet all of the following criteria: (1) a neurocutaneous defect at the proximal phalanx; (2) a

Table 1
Characterisation of the sample.

Variable	Study group	Comparative group	<i>p</i> value
Age (year)	32.7 ± 6.7	32.3 ± 7.7	.86*
Sex			
Male	9 (75)	19 (79)	.78 [†]
Female	3 (25)	5 (21)	
Soft-tissue loss	4.5 ± 1.1	4.7 ± 1.1	.60*
Nerve defect (cm)	2.8 ± 0.7	2.5 ± 0.5	.13*
Follow-up (month)	22.4 ± 2.6	22.2 ± 2.0	.79*

A value $p < .05$ was set as statistically significant. **t* test; [†]Pearson's chi-square test.

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