Journal of Plastic, Reconstructive & Aesthetic Surgery (2014) 67, 1129—1135

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Anatomy of the direct small branches of the proper digital nerve of the fingers: A cadaveric study

Jihyeung Kim [b], Young Ho Lee [a,*], Min Bom Kim [a], Seung Hwan Rhee [b], Goo Hyun Baek [a]

[a] *Department of Orthopedic Surgery, Seoul National University College of Medicine, Seoul, South Korea*
[b] *Department of Orthopedic Surgery, Seoul National University Boramae Medical Center, Seoul, South Korea*

Received 11 October 2013; accepted 29 April 2014

KEYWORDS
Anatomy;
Cadaveric study;
Direct small branch;
Proper digital nerve

Summary *Background and aim:* The purpose of this study was to evaluate the anatomical constancy of the direct small branches of the proper digital nerve.
Methods: A total of 208 digital nerves of the index, long, ring, and little fingers from 13 cadavers were studied. For each digital nerve, the number of direct small branches was counted at the proximal and middle phalanx levels. In addition, the diameter of these branches was measured at the level of the branch bifurcation. We also measured the diameter of the proper digital nerve at the level of the distal interphalangeal (DIP) joint.
Results: The direct small branches of the proper digital nerve were anatomically constant among the index, long, and ring fingers. The average number of direct small branches was 2.7 at the proximal phalanx level and 2.3 at the middle phalanx level. At the level of the DIP joint, the average thickness of the proper digital nerve was 0.85 mm in the index finger, 0.84 mm in the long finger, 0.72 mm in the ring finger, and 0.49 mm in the little finger.
Conclusion: In this study, we verified the anatomical constancy of the direct small branches of the proper digital nerve. The size of these branches at the proximal phalanx level was similar to that of the corresponding proper digital nerve at the level of the DIP joint. Therefore, these nerve branches at the proximal phalanx could be applied to the creation of various sensate flaps for the reconstruction of the fingertip injuries.

* Corresponding author. Department of Orthopedic Surgery, Seoul National University College of Medicine, Seoul National University Hospital, 101 Daehak-ro, Jongno-gu, Seoul 110-744, South Korea. Tel.: +82 2 2072 0894, +82 10 6331 1768 (mobile); fax: +82 2 764 2718.
E-mail address: orthoyhl@snu.ac.kr (Y.H. Lee).

http://dx.doi.org/10.1016/j.bjps.2014.04.026

By the nature of their function, the fingertips are exposed to the environment in many of our daily activities. Because of this, fingertip injuries are one of the most common injuries of the hand.[1] The aim of fingertip reconstruction is to restore a functional and cosmetically acceptable fingertip while minimizing problems for the patients. Although traditional reconstructive techniques, such as the thenar flap[2] and cross-finger flap,[3,4] are useful, they require two surgical procedures, cause joint stiffness from prolonged immobilization, and provide poor sensory recovery. Because the fingertips are highly specialized to allow for a wide variety of tasks, the restoration of sensation is extremely important. If digital nerve neurorrhaphy is not performed, a painful neuroma may develop from the injured digital nerve stump.[5,6] Therefore, a donor flap should ideally contain more than two nerves for neurorrhaphy with two digital nerve stumps, and the diameter of the nerves must be similar to that of the injured digital nerve stump.

Tellioglu and Sensoz had performed an anatomical study on the dorsal branch of the digital nerve and suggested an innervated cross-finger flap using both of the dorsal branches.[7] Bas and Kleinert conducted an anatomical study of the sensory nerves of the digits.[8] In that study, they reported the anatomical relationships of the median nerve, ulnar nerve, superficial branch of the radial nerve, dorsal branch of the ulnar nerve, and the dorsal branch of the proper digital nerve. However, no anatomical study of the small branches directly rising from the proper digital nerve has been conducted. Lee et al. first mentioned the direct small branches of the proper digital nerve, suggesting the creation of an innervated lateral middle phalangeal finger flap.[9] They coapted the direct small branches and the dorsal branch of the proper digital nerve to injured nerve stumps and reported that these direct small branches innervated the ipsilateral volar half of the donor flap at the middle phalanx. If the anatomical constancy of the direct small branches is verified, these branches can be applied to the creation of various sensate flaps for fingertip reconstruction. As one of these applications, we created the homodigital innervated reverse digital artery flaps using these small branches. Thus, we planned the present study to verify the anatomical constancy of these direct small branches from the proper digital nerve.

Materials and methods

For this study, 26 hands from 13 fresh-frozen cadavers (<48 h after death) were used. The group of cadavers comprised six males and seven females (average age at the time of death, 77 years). In the male cadavers, the average height was 167 (range, 162—175) cm and the average body weight was 70 (range, 62—77) kg. In the female cadavers, the average height was 156 (range, 151—163) cm and the average body weight was 63 (range, 54—67) kg. A total of 208 proper digital nerves were dissected from the index, middle, ring, and little fingers with the aid of 5.5× loupes. Each dissection was initiated by longitudinally removing the skin from the radial and ulnar sides of the finger from the metacarpophalangeal (MCP) joint to the fingertip, while preserving subcutaneous fat tissues that may contain the direct small branches of the proper digital nerve (Figure 1). We explored the proper digital nerve and separated the volar side of the proper digital nerve from the surrounding soft tissue. Because the small branches originate from the proper digital nerve and travel dorsally, we paid special attention to avoid injuring the direct small branches when approaching the dorsal side of the proper digital nerve. Upon completion of the dissection, we counted the respective numbers of direct small branches at the levels of the proximal and middle phalanges (Figure 2). We also evaluated the branching levels of the direct small branches in the proximal and middle phalanges. We divided the proximal phalanx into four quarters and counted the number of small branches at each level. We defined the most proximal quarter as 1Q, the second-most proximal quarter 2Q, the third-most proximal quarter as 3Q, and the most distal quarter as 4Q. We performed similar measurements in the middle phalanx.

The diameters of the direct small branches were measured at the level of the branch bifurcation. We also

Figure 1 We dissected the index, long, ring, and little fingers of 26 cadaveric hands, focusing on the direct small branches of the digital nerve at the proximal and middle phalanx levels.

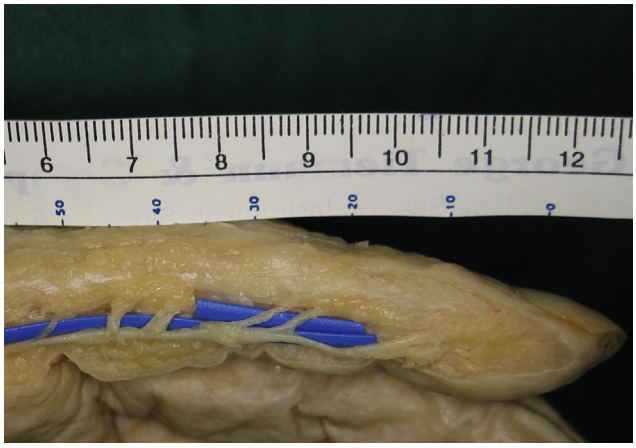

Figure 2 There were three and two direct small branches in the proximal and middle phalanges, respectively. Using a scaled millimeter ruler as a reference, the sizes of these branches were calibrated with digital imaging software.