

# Transfer of the Motor Branch of the Abductor Digiti Quinti for Thenar Muscle Reinnervation in High Median Nerve Injuries

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**Purpose** In high median nerve repairs, thenar muscle reinnervation is impossible because of the long distances over which axons must regenerate. To overcome this obstacle, we propose transferring the abductor digiti quinti motor branch (ADQMB) to the thenar branch of the median nerve (TBMN).

**Methods** We used 10 embalmed hands for anatomical and histological studies. Thereafter, 5 patients with a high median nerve injury underwent surgical reconstruction within 8 months of their accident and were followed for at least 10 months after surgery (mean, 13.2 months). We transferred the ADQMB to the TBMN. The median nerve was grafted in 4 patients and the motor branch of the extensor carpi radialis brevis was transferred to the anterior interosseous nerve in 3. Patients had pre- and postoperative evaluations of thumb range of motion and strength.

**Results** In cadaveric hands, the ADQMB was the first branch of the ulnar nerve to arise near the pisiform bone. The TBMN arose from the anterior surface of the median nerve, underneath the flexor retinaculum. Retrograde dissection of the TBMN allowed tension-free coaptation with the ADQMB. Both branches contained approximately 650 myelinated fibers. After surgery, all our patients improved thumb pronation, thenar eminence bulk, and abductor pollicis brevis British Medical Research Council score. They recovered approximately 75% of their normal-side grasp and pinch strength. No patient lost little finger abduction.

**Conclusions** Transfer of the ADQMB to the TBMN reinnervated the thenar muscles, which improved thumb range of motion and strength. (*J Hand Surg Am.* 2017; ■(■): ■–■. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)

**Type of study/level of evidence** Therapeutic V.

**Key words** Nerve transfer, nerve grafting, median nerve palsy, nerve repair, high median nerve injury.



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Received for publication March 2, 2017; accepted in revised form August 4, 2017.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/17/ ■ ■ -0001\$36.00/0  
<http://dx.doi.org/10.1016/j.jhsa.2017.08.009>

**I**N MEDIAN NERVE LESIONS, THUMB opposition is partially preserved. Abduction is promoted by thumb muscles innervated by the radial nerve, and flexion is ensured by the flexor pollicis brevis, which is partially innervated by the ulnar nerve.<sup>1</sup> However, despite some motion preservation, pinch strength generally is diminished by about 60% in low median nerve paralysis<sup>2</sup> and 70% in high median nerve lesions, which also result in paralysis of the flexor pollicis longus.<sup>1</sup> Hence, not only enhancing range of motion but also increasing strength through thenar muscle reinnervation are important during reconstruction of thumb function after a median nerve injury.

Direct repair of the median nerve injured at the level of the wrist results in thenar muscle reinnervation in two-thirds of patients.<sup>3</sup> However, with above-elbow lesions, median nerve repair does not ensure thenar muscle reinnervation.<sup>4</sup> Poor reinnervation of thenar muscles results not only from limited nerve regeneration through long distances and invalid regrowth<sup>5</sup> but also from muscle atrophy after prolonged denervation.<sup>6</sup> These drawbacks of direct nerve repairs that are distant from their muscle targets can be minimized using distal nerve transfers.<sup>7</sup>

In high median nerve injuries, we have hypothesized that transferring the motor branch of the abductor digiti quinti (ADQMB) to the thenar branch of the median nerve (TBMN) would be a feasible way to reinnervate thenar muscles.

In this report, we describe our anatomical findings in 10 hand dissections performed on cadavers and our surgical outcomes in 5 patients treated surgically for a high median nerve injury.

## METHODS

### Anatomical study

In 10 embalmed hands, a midpalmar incision was made to dissect the motor branches of the ulnar nerve to the adductor digiti quinti (ADQ) muscle as well as the TBMN. Guyon canal was released. As anatomical landmarks, we used the center of the pisiform for the origin of the ADQMB and the distal margin of the flexor retinaculum for the origin of the TBMN. With a caliper, we measured the distance between the origin to the point of entrance into the muscle (length) of the ADQMB and TBMN. After creating semithin transverse nerve sections and staining them with toluidine blue, we determined the number of nerve fascicles, the global and endoneurial area, and the estimated total number of myelinated axons within the ADQMB and TBMN. Nerve specimens

for histological studies were prepared and examined, as described in a previous report.<sup>8</sup>

Values were recorded as mean  $\pm$  SD.

### Clinical study

The local ethics committee approved the protocol of the clinical trial in advance of any data collection. Patients also provided written informed consent before participation, in accordance with the Declaration of Helsinki guiding biomedical research involving human subjects.

Over a 3-year period, we operated on 5 patients with a high median nerve injury. Four men and a woman underwent our current nerve transfer strategy and were included in the present study. That strategy consists of transferring the extensor carpi radialis brevis motor branch to the anterior interosseous nerve when available ( $n = 3$ )<sup>9</sup> and the ADQMB to the TBMN. We grafted the median nerve in 4 of these 5 individuals (Table 1). Sensory reconstruction was performed using distal nerve transfers from the radial nerve, as reported previously.<sup>10</sup>

Before surgery, all patients had been evaluated for grasp and pinch strength with appropriate dynamometers (Baseline, New York, NY). During our measurement of grasp and lateral pinch strength, each patient was seated with the elbow and wrist extended to 120° and 30°, respectively. In patients with combined median and radial nerve palsy, during the grasp and pinch strength assessment, the examiner held the patient's wrist in 30° of extension. To measure grasp strength, the handle of the dynamometer was in position 2. For the dynamometric studies, 2 trials were performed and the best attained result used for statistical evaluation.

We scored the bulk of the thenar eminence from 1 to 5 by visual inspection and palpation. From the resting position, we asked patients to abduct their thumb while resistance was applied at the metacarpophalangeal joint from the lateral side. Abductor pollicis brevis (APB) strength was scored from 0 to 5, in accordance with the British Medical Research Council rating scale.<sup>11</sup> Thumb range of opposition was assessed by means of the Kapandji score.<sup>12</sup> We scored thumb pronation using the Bourrel angle,<sup>13</sup> which we refer to as thumb pronation. We asked patients to place the pulp of their thumb onto the pulp of their ring finger. Photographs were obtained, and the angle between the nails of the thumb and the ring finger was measured using ImajeJ public domain software.

Values were recorded as means  $\pm$  SD. Pre- and postoperative means were compared using paired,

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