

Thumb Reconstruction Using Transfer of the Ring Finger Without Vascular Anastomosis

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Purpose This study describes the results of the ring finger transfer technique for thumb reconstruction.

Methods Five fingers of 4 patients aged 23–57 years who presented to our clinic with an amputated thumb between 2017 and 2019 were included in this study. The results were assessed using Disabilities of Arm, Shoulder, Hand (DASH) scoring. Active range of motion, grip and pinch strengths, Kapandji scores, and static 2-point discrimination were measured.

Results The mean age of the patients (3 men, 1 woman) was 37 years (23–57 years). The level of amputation was the proximal phalanx in 3 digits and metacarpal in 2 digits. The average procedure time of was 89 ± 12 minutes. The average follow-up duration was 13 months (12–16 months). There was no total or partial digit necrosis in any patient. The mean preoperative shortened DASH score was 52.5 ± 6.7 , and the mean postoperative score was 5.3 ± 6.5 . The mean preoperative DASH Work Module score was 81.2 ± 18.8 and the mean postoperative score was 13.8 ± 7.5 . Two-point discrimination was normal.

Conclusions Transfer of the ring finger to reconstruct the amputated thumb is an alternative reconstruction method for patients who do not accept toe-to-thumb and pollicization techniques. (*J Hand Surg Am.* 2022;47(7):686.e1-e6. Copyright © 2022 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Therapeutic IV.

Key words Finger transfer, pollicization, reconstruction, ring finger, thumb.



THE THUMB IS FUNCTIONALLY THE most important digit in the hand. Although multiple techniques have been reported for reconstruction of the thumb after its loss following amputation, all

have disadvantages.^{1–3} The toe-to-thumb transfer is accepted as the best technique for thumb reconstruction, but it requires microsurgical expertise and can result in complications, like circulatory failure and necrosis. In addition, at least 6 months are required for recovery of sensory function.^{4,5}

Although pollicization of the index finger is among the most preferred techniques for thumb reconstruction, it was reported that functional impairment may develop in the middle finger and grip strength may decrease after pollicization.^{6,7} Some patients may not accept the loss of the index finger's function and others may refuse pollicization procedures for social, cultural, or religious reasons.^{6,8}

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In some cultures, the loss of a toe may be unacceptable.^{9,10} A case report describing pollicization of the ring finger was previously reported, but thumb reconstruction required a total of 3 procedures in this report.¹¹ In an experimental study, it was shown that the little finger could be transferred to the thumb by protecting the digital artery, nerve, and flexor tendons, but only if the extensor tendons and the dorsal veins are divided.¹² Although Tubiana et al¹³ claimed that the ring finger's loss leaves the least functional deficit in the hand, it is widely accepted that a power grasp is primarily accomplished by the ulnar digits. Other authors consider the index finger to be a functionally important finger.¹⁴

This study describes transfer of the ring finger for thumb reconstruction.

MATERIALS AND METHODS

Four patients aged 23–57 years who presented to the Department of Plastic & Reconstructive and Aesthetic Surgery at the Meram Faculty of Medicine between 2017 and 2019 with an amputated thumb were included in this prospective study. One patient had sustained bilateral thumb amputations. In all cases, the amputations could not be replanted and the patients did not accept the options of toe-to-thumb transfer or pollicization of the index finger for thumb reconstruction. Patients with diabetes mellitus, with peripheral vascular diseases, with heart failure, who were smokers, or who were in generally poor health status were excluded from the study. Informed consent was obtained from each patient. The study was approved by the local ethics committee and conformed to the Declaration of Helsinki.

The outcomes were measured using the shortened Disabilities of the Arm, Shoulder, and Hand (*QuickDASH*).¹⁵ The ability to do work was calculated using the DASH Work Module score.

Active range of motion (ROM) for the reconstructed interphalangeal and metacarpophalangeal (MCP) joints were assessed with a goniometer, and grip and pinch (lateral, palmar, 3-point) strengths, Kapandji opposition scores,¹⁶ and static 2-point discrimination were also measured. Two-point discrimination was assessed in the middle of the distal phalanx palmar surface of the reconstructed thumb. The grip and pinch strengths were measured according to percentages of age-related normal values, because 1 of the patients lost both of his thumbs, precluding comparison with the contralateral side.¹⁷

Surgical technique

The ring finger was mobilized after dissection of digital arteries, dorsal and palmar veins, nerves, and flexor and extensor tendons, including the flexor tendon sheath (Fig. 1A; Video E1, available online on the Journal's website at www.jhandsurg.org). On the dorsal side of the digit, the dorsal digital veins, bone, and the extensor tendon of the ring finger were divided at the mid-level of the proximal or middle phalanx. The digital artery and nerve on the radial side, palmar veins, and the flexor digitorum profundus (FDP) tendon of the ring finger were protected. The ulnar digital artery of the middle finger was divided, but the radial side was protected (Fig. 1B). The flexor digitorum superficialis tendon was sutured to the bone of the ring finger stump in order to allow active MCP flexion. The ulnar digital artery of the transferred finger was protected to maintain the stump circulation. The proximal or middle phalanx of the ring finger was fixed to the metacarpal or proximal phalanx of the thumb using Kirschner wire or a titanium plate (Fig. 1C). The extensor tendons of the thumb were sutured to the extensor tendon of the ring finger, and the FDP was sutured with a 3/0 polypropylene suture, using a modified Kessler method, to the flexor pollicis longus tendon in carpal tunnel (Fig. 1D).

A skin defect area measuring 1 cm by 1 cm at the junction of the transferred digit and the thumb stump was covered with a split-thickness skin graft to prevent compression of the pedicle. Patients in whom a titanium plate was used for bone fixation started active movement in the third postoperative week and patients in whom a Kirschner wire was used for bone fixation started active movement in the sixth postoperative week. A Kleinert rehabilitation protocol was used for the flexor tendon repair. All patients underwent passive movement from the first postoperative day until the start of active movement.

RESULTS

The mean age of the patients (3 men, 1 woman) was 37 years (23–57 years). The level of amputation was the proximal phalanx in 3 digits and the metacarpal in 2 digits (Fig. 2). The cause of amputation was trauma in 4 digits and tumor in 1 thumb (Table 1). All patients underwent thumb reconstruction 12 months after amputation. The average duration of the operation was 89 ± 12 minutes. The average follow-up time was 13 months (12–16 months). There was no total or partial digit necrosis in any patient. None of the patients had complications. All patients were able

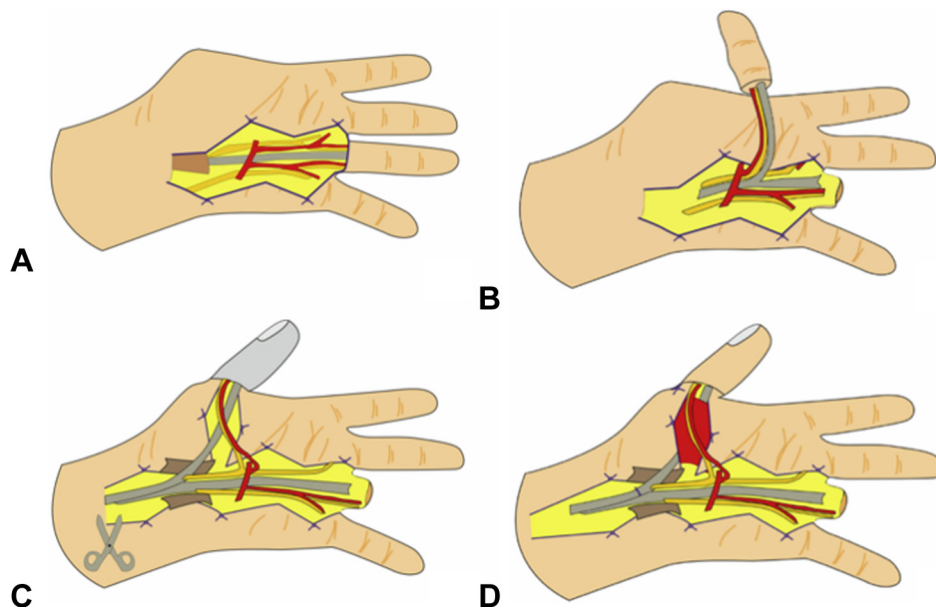


FIGURE 1: **A** Dissection of the fourth finger's vein, nerves, and tendons, **B** harvesting of the finger on the radial side pedicle, **C** transfer of the fourth finger to the thumb, and **D** fixation of the finger and fixation of the FDP tendon to the flexor pollicis longus tendon under the thenar muscle in the carpal tunnel.

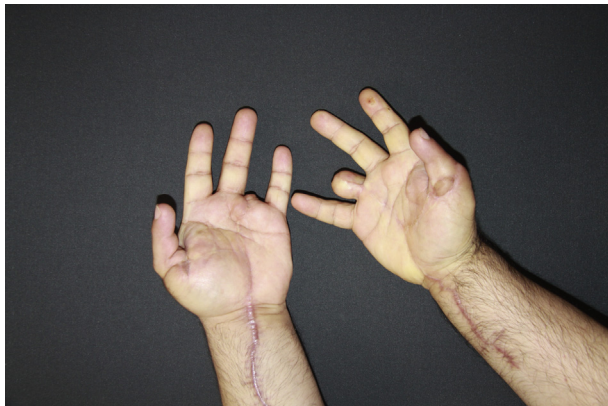


FIGURE 2: Postoperative appearance of the hand of a patient with both thumbs amputated.

to perform flexion movements at the end of the third month and were able to perform opposition movements at the end of the second month (Fig. 3). A flexor tenolysis was performed in 1 of the thumbs. The mean preoperative and postoperative static 2-point discrimination values in the ring finger were 2.9 ± 0.2 mm and 3.9 ± 0.7 mm, respectively. Bone fixation was performed using Kirschner wire in 1 digit and a titanium plate in 3 digits. The patients averaged 80% (minimum, 68%; maximum, 87%) grip strength, 68% (minimum, 58%; maximum, 77%) lateral pinch, 62% (minimum, 58%; maximum, 70%) palmar pinch, and 51% (minimum, 40%; maximum,

61%) 3-point pinch compared with normal standards defined by age and sex.

The average ROM of the reconstructed interphalangeal joint of the thumb was 52° (range, 36° – 58°) and the average MCP was 41° (minimum, 38° ; maximum, 45°). The averaged Kapandji opposition score was 7.1 ± 0.9 at 12 months after surgery (Fig. 4).

The mean preoperative *QuickDASH* score was 52.5 ± 6.6 and the mean postoperative score was 5.1 ± 6.4 . The mean preoperative *DASH* Work Module score was 81.2 ± 18.7 and the mean postoperative score was 13.7 ± 7.5 . There was no donor site complication or bone union problem.

DISCUSSION

Total thumb amputation causes loss of 35% to 45% of hand functions, as well as psychological and social problems.^{18–20} There are several case reports describing the pollicization of the ring finger,^{11,21} but the thumb reconstructions were completed in multiple steps in these reports.¹¹ The width of the hand is reduced in a ray amputation; therefore, opposition can be made more easily. If the patient does not want an amputation stump, ray amputation of the ring finger can be performed. However, ray amputation was refused by all patients in our study.

TABLE 1. Data of Patients*

| Characteristic | Patient 1 | Patient 2 | Patient 3 | Patient 4 |
|---|------------------|-------------|------------------|--------------------------------|
| Sex, age | Male, 21 | Male, 57 | Female, 32 | Male, 38 |
| Level of amputation | Proximal phalanx | Metacarpal | Proximal phalanx | Proximal phalanx Metacarpal |
| Mechanism | Trauma | Tumor | Trauma | Trauma |
| Secondary surgery | None | None | None | Tenolysis None |
| ROM, [†] degrees | 58–41 | 36–38 | 57–45 | 53–39 56–42 |
| Grip strength [‡] | 83 | 68 | 85 | 80 84 |
| Pinch, [‡] lateral/palmar/3-point | 70/63/53 | 58/58/40 | 71/65/56 | 69/60/51 72/64/55 |
| Kapandji score | 7 | 6.5 | 8 | 7.4 6.7 |
| QuickDASH score, preoperative to postoperative | 48.33–4.13 | 50.83–11.66 | 45.83–2.58 | 58.33–3.33 59.16–4.16 |
| 2-PDD, [§] mm, preoperative to postoperative | 2.7–4.1 | 3–3.2 | 2.9–4.6 | 2.8–4.4 3.1–3.2 |

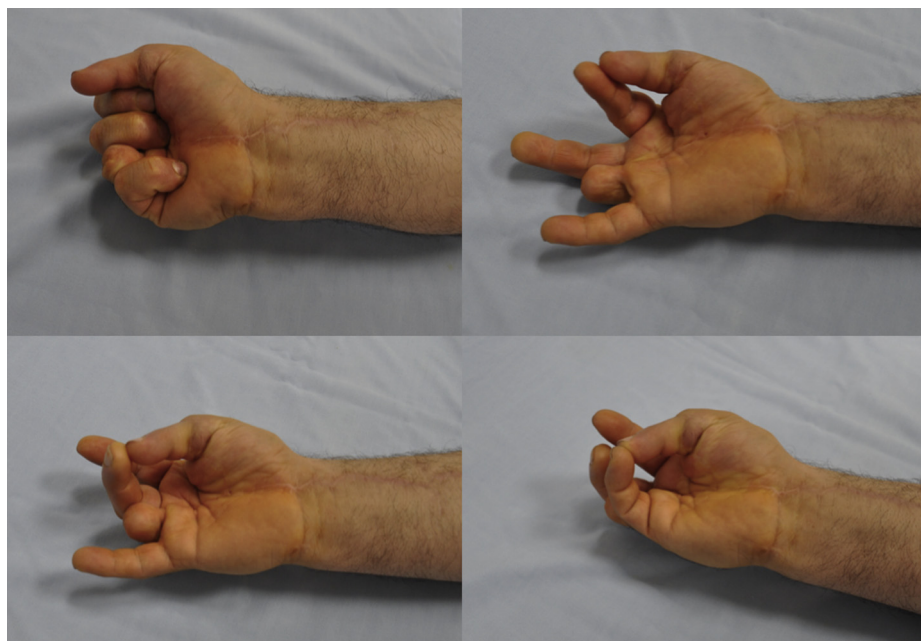
2-PDD, 2-point discrimination distances; IP, interphalangeal.

*Functional measures were performed at the twelfth month after surgery.

[†]Active ROMs for the IP and MCP joints.

[‡]The grip and pinch strengths were measured according to percentages of age-related normal values.

[§]Static 2-PDD.

**FIGURE 3:** Functions of the thumb at the third month after surgery.

In our technique, the length of the thumb can be adjusted as required. Thumb reconstruction can be performed in a single session because palmar veins were protected in our technique.

In our cases, reconstruction was delayed, so the tendons were retracted; however, this did not pose a problem because the FDP was transferred to the thumb and the length of the tendon was sufficient.

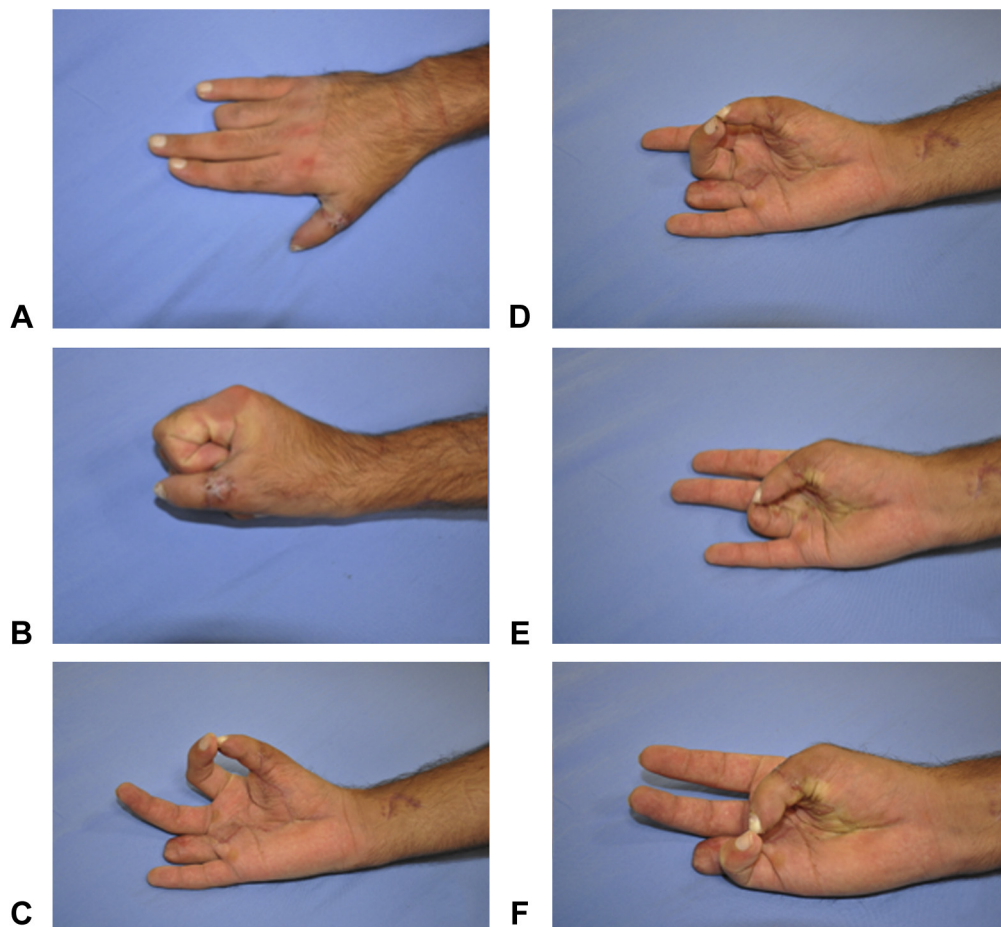


FIGURE 4: Functions of the thumb at the sixth month after surgery.

Immediate reconstruction could be performed if the ring finger is not damaged.

Loss of sensation did not occur. It has been reported that reconstruction with innervated flaps in the upper extremity may cause a sensation referable to the donor area in adults.²² Two of the patients perceived the neo-thumb as their donor site ring finger at 2 months after surgery; however, this phenomenon completely disappeared by the sixth month after surgery.

In pollicization involving the index finger, the reconstructed finger is longer than a normal thumb.²³ However, the optimal finger length for the thumb can be adjusted in our technique. It is known that the ring and little fingers are together very important for power gripping. Because the stump of the ring finger was preserved, the loss of the distal portion of the digit did not seriously impair grip strength in our patients.

This study demonstrates that thumb reconstruction can be performed with ring finger transfer, which is a 1-step procedure without vessel anastomosis. Further clinical studies are needed to determine the

complication rates of this technique. This technique is an alternative reconstruction method for patients who do not accept toe-to-thumb transfer and pollicization techniques.

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