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CASE REPORT

Hand/Peripheral Nerve

# Free Functional Muscle Transfer for Thumb Opposition

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**Summary:** Traumatic injuries and other conditions resulting in thenar loss and loss of opposition function can cause significant functional limitations. There are limited options available to restore function and bulk to the thenar musculature. A 26-year-old man had an unfortunate accident at work with a machine mixer creating a crush injury to his left hand. This required several debridements due to the tissue injury and resulted in loss of the thenar muscles and ability to oppose the thumb. He recovered well from the initial injury, however, was left with difficulty with grasp and holding objects due to the loss of thenar motion and strength. His function was also affected by the loss of bulk. He successfully underwent a free functional muscle reconstruction with his serratus anterior. This case report is a description of his reconstruction and a review of the literature. The patient had an excellent outcome. He obtained active opposition and improved grip strength, improving his activities of daily living and vocational life. The serratus anterior muscle can successfully be used for thumb opposition reconstruction. This case report demonstrates good outcomes for both motion and bulk restoration. *(Plast Reconstr Surg Glob Open 2018;6:e1736; doi: 10.1097/GOX.0000000000001736; Published online 10 May 2018.)*

Free functional muscle transfer (FFMT) is a good option for functional reconstruction in situations where less complicated options are not available. To restore thumb opposition, tendon transfers, such as an extensor indicies transfer, would be a common option. This is sometimes not an option if there is injury to the adjacent index finger, and the tendon transfer does not restore thenar bulk. Patients who can potentially benefit from FFMT include patients with loss of muscle from long-standing neurologic injuries, electrical injuries, posttumour excision, and after traumatic loss.[8] It is common for these patients to have loss of function from a certain muscle, or group of muscles. For optimal outcomes, it is ideal to have existing antagonistic forces to the area for reconstruction.[10] Common FFMT include the use of the gracilis muscle to restore elbow flexion, or finger flexion. The history and technical details behind success for these transfers have already been described.[10] By applying these principles, FFMT can be expanded to other less common areas to restore function, such as thumb opposition.

## CASE DETAILS

The patient had maximized his recovery through therapy and still had a significant functional deficit. As well, the loss of thenar bulk was bothersome with grip activities. He was consented for functional and soft-tissue reconstruction using a free functional serratus muscle.

The hand was explored first, and the median nerve was traced from proximal into the area of scar. The recurrent motor branch fascicular bundle was identified proximally and traced distally into scar in the thenar area. The digital nerve branches were neurolysis. Under the microscope, the recurrent motor branch was freshened until healthy proximal fascicles were visualized. The radial artery was prepared for free tissue transfer. A space was created subcutaneously both in the thenar region, and hypothenar, for positioning, insetting, and tensioning the free functional serratus muscle transfer (Fig. 1).

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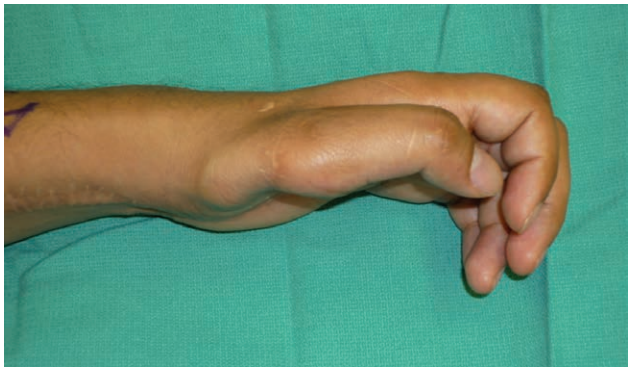

**Fig. 1.** Preoperative assessment with loss of opposition function and significant loss of thenar bulk.

The lower 2 slips of the serratus anterior muscle were harvested in the standard fashion with the blood supply based on the serratus branch from the subscapular artery. The long thoracic nerve branches to these slips were identified and traced retrograde to isolate them from the rest of the nerve innervating the more superior slips. This allowed for preservation of the upper slips of the muscle supplied by the lateral thoracic artery and proximal long thoracic nerve.

Once the lower slips of muscle were isolated, their resting length was marked. The muscle was then released, the serratus artery was ligated, and the long thoracic nerve fascicles to the lower slips were isolated as proximal as possible without disrupting the nerve to the rest of the muscle. The muscle was then brought to the hand for opposition reconstruction.

The muscle was spanned from the hypothenar subcutaneous pocket to the thenar pocket and the resting length was restored (Fig. 2). The insertion was recreated into the volar, radial periosteum of the base of the proximal phalanx. The vascular anastomosis was performed to the radial artery and vena commitante. The nerve coaptation was performed to the recurrent branch of the median nerve. A small, unmeshed skin graft was placed over the muscle centrally to ensure the closure was not too tight over the muscle.

Postoperatively, the patient did well. At 3 weeks, he started working on passive range of motion and was otherwise maintained in a custom thumb spica splint to prevent first webspace collapse. He started to see activation of the muscle both on EMG and clinically at 6 months. By 18 months, he was able to demonstrate active opposition and improved grip strength, improving his activities of daily living and vocational life (Fig. 3).

## DISCUSSION

FFMT can be an excellent technique when used for the right indications to improve function that has been lost in the upper extremity. More common areas for reconstruction are elbow flexion and finger flexion, and the gracilis muscle has been a workhorse for this purpose.[10] There have been some novel descriptions for thumb opposition reconstruction in the literature.[1,4,5,9,11,12] The serratus anterior muscle has also been well described and has favorable anatomy for being a donor muscle used in FFMT. Logan et al.[7] outlined the benefits of this muscle, including, the

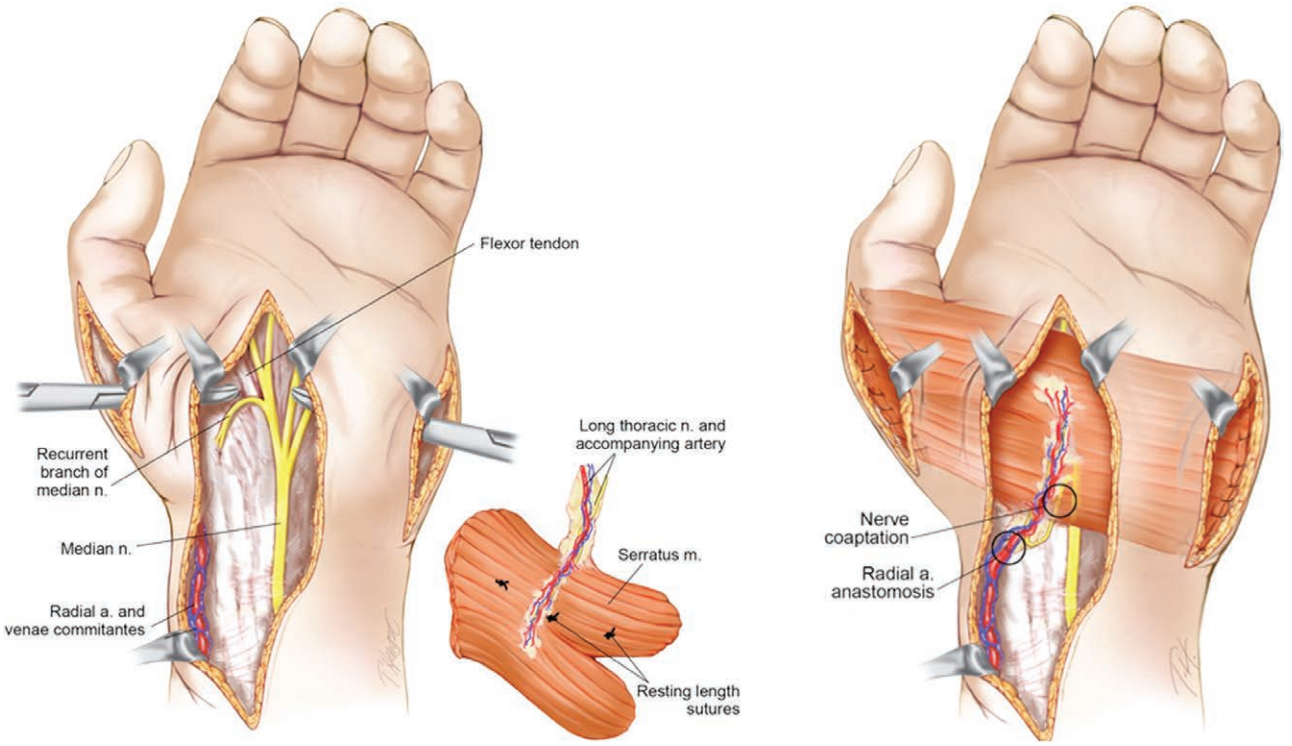


**Fig. 2.** Preparation of origin and insertion in hypothenar and thenar areas for the hand. Coaptation of the recurrent motor branch of the median nerve to the long thoracic nerve of the serratus muscle to innervate the FFMT.

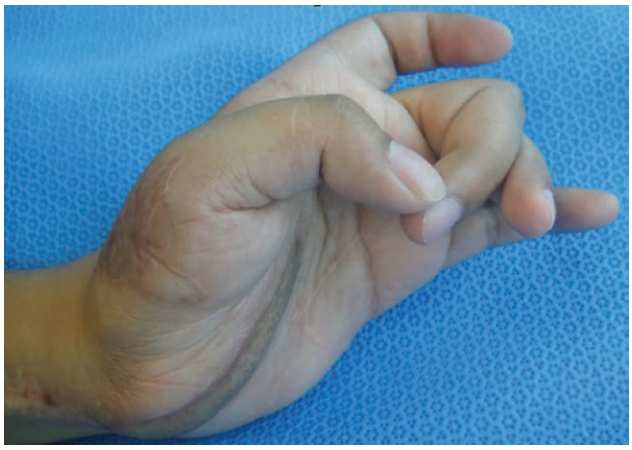

**Fig. 3.** Opposition retraining postoperatively with good improvement in thenar bulk.

relatively easy harvest, long reliable vascular pedicle, thin and easily contoured slips that could be separated, and the ability to dynamically reinnervate this muscle.

The serratus anterior FFMT is commonly used for reconstruction of other challenging problems, such as facial reanimation, and this leads to the ability to study its reliability and donor-site issues. In a report on 100 consecutive cases, there was a reported 99% success rate with the flap and no donor-site functional loss.[2] The anatomy of the serratus anterior muscle has further been described demonstrating the ability to separate the muscle slips further into deep and superficial slips, again highlighting the versatility of the flap and ability to utilize multiple slips to create different force vectors.[3,6]

In a series of 15 transfer between 1979 and 1985, 3 of these were FFMT using the serratus anterior.[7] In that article, it was demonstrated how the muscle could be transferred in the setting of using a great toe transfer for thumb reconstruction, to augment thenar function, and the authors concluded that the flap could have many different applications to difficult hand coverage problems.[7] In a subsequent article, the same group reported on the usefulness of the multiple slips for palmer defect coverage.[2]

By utilizing the principle of FFMT that are well described, the serratus anterior muscle is shown to successfully be used for thumb opposition. Our case report helps to support this muscles use for both motion and bulk, helping to successfully restore grip function.

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## REFERENCES

1. Baker PA, Watson SB. Functional gracilis flap in thenar reconstruction. *J Plast Reconstr Aesthet Surg.* 2007;60:828–834.
2. Brody GA, Buncke HJ, Alpert BS, et al. Serratus anterior muscle transplantation for treatment of soft tissue defects in the hand. *J Hand Surg Am.* 1990;15:322–327.
3. Godat DM, Sanger JR, Lifchez SD, et al. Detailed neurovascular anatomy of the serratus anterior muscle: implications for a functional muscle flap with multiple independent force vectors. *Plast Reconstr Surg.* 2004;114:21–29; discussion 30.
4. Ibaraki K, Kanaya F. Free vascularized medial plantar flap with functioning abductor hallucis transfer for reconstruction of thenar defects. *Plast Reconstr Surg.* 1995;95:108–113.
5. Işik S, Sezgin M, Oztürk S, et al. Free musculofasciocutaneous medial plantar flap for reconstruction of thenar defects. *Br J Plast Surg.* 1997;50:116–120.
6. Lifchez SD, Sanger JR, Godat DM, et al. The serratus anterior subslip: anatomy and implications for facial and hand reanimation. *Plast Reconstr Surg.* 2004;114:1068–1076.
7. Logan SE, Alpert BS, Buncke HJ. Free serratus anterior muscle transplantation for hand reconstruction. *Br J Plast Surg.* 1988;41:639–643.
8. Muramatsu K, Ihara K, Taguchi T. Selection of myocutaneous flaps for reconstruction following oncologic resection of sarcoma. *Ann Plast Surg.* 2010;64:307–310.
9. Ng ZY, Lee SW, Mitchell JH, et al. Functional anconeus free flap for thenar reconstruction: a cadaveric study. *Hand (N Y).* 2012;7:286–292.
10. Seal A, Stevanovic M. Free functional muscle transfer for the upper extremity. *Clin Plast Surg.* 2011;38:561–575.
11. Tamai S, Fukui A, Shimizu T, et al. Thumb reconstruction with an iliac bone graft and a dorsalis pedis flap transplant including the extensor digitorum brevis muscle for restoring opposition: a case report. *Microsurgery.* 1983;4:81–86.
12. Zhuang YQ, Xiong HT, Fu Q, et al. Functional pectoralis minor muscle flap transplantation for reconstruction of thumb opposition: an anatomic study and clinical applications. *Microsurgery.* 2011;31:365–370.