Original Article

Refinements in the design and division of the thenar flap to achieve better functional results

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ABSTRACT

Though the thenar flap has been described since 1926, its use has not been widespread. The main criticisms are donor site morbidity and proximal interphalangeal joint (PIP) stiffness. In this paper, we describe a standard design technique for flap design and division to address these two issues. From July 2018 to April 2019, a total of ten patients underwent thenar flap reconstruction of the fingertip. The flap dimensions ranged from 10 mm × 10 mm to 25 mm × 15 mm. All the flaps survived. One patient developed wound infection post-division. All donor sites were closed primarily without skin graft. We are using mirror image technique to elevate the flap to ensure that it is inset in the position as we planned without displacement. It largely reduced the chance of rotation and extensive tension when fix the finger to the thenar region. Our technique allows for the flap design to be individually customized based on the orientation of the defect, making it simpler and more replicable. We have also emphasized how care during division of the thenar flap can help prevent complications.

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**Introduction**

The thenar flap is more often used for larger volar defects, especially radial volar defects of the index and middle fingers. In Gatewood’s classical description of the thenar flap in 1926, the flap was placed high on the thenar eminence near the metacarpophalangeal (MCP) flexion crease of the thumb and was based medially. In 1957, Flatt introduced the proximally based thenar flap, which encroached significantly upon the palm. Smith and Albin subsequently described the H-shaped modification to it, whereby a 2 cm x 4 cm thenar flap can be harvested from the MCP crease and still allow primary closure of the donor site with thumb flexion. In 1996, the distally based thenar flap was described in a series of 20 patients. As can be seen from the numerous reported variations, there are many ways to design the thenar flap for coverage of fingertip defects. The advantages of the thenar flap include good soft tissue padding, good colour and texture match, as well as inconspicuous donor scars that can be closed primarily without skin grafts.

Despite these advantages, there has been some reluctance to utilize this versatile flap. The main reason being that the thenar flap requires the digit to be immobilized in flexion for two to three weeks before division. The fear of developing PIPJ contractures led many authors to recommend this technique only for children and adults less than 30 years old. Nevertheless, Melone et al. has reported favourable outcomes in older patients with only six of patients in a series of 150 flaps developing a PIPJ contracture.

Another concern is with regards to difficulties encountered during flap design, inset and division. In the typical thenar flap design, the injured finger is flexed to make contact with the flap that has been elevated from the thenar region. Excessive tension, rotation or flexion of the finger results in difficulty in suturing. Thirdly, the traditional thenar flap is designed mainly for radial oblique fingertip amputation. Therefore, when the defect is more volar or ulnar, the thenar flap may not be able to fully cover the defect. Furthermore, if division is not performed correctly, there will be a remnant defect on the volar aspect of the finger pulp. This is an unacceptable outcome for the surgeons.

The thenar flap is not easy to design, especially for inexperienced hand surgeons, however, it is still useful nowadays when need to cover a fingertip defect in emergency operation theatre, and it is a useful technique for training of flap design for the junior hand surgeons. In this paper, we describe a technique that assists in the visualization of the final outcome during the initial design of the thenar flap as well as during flap division. This allows the thenar flap to be customized in order to resurface a wide variety of fingertip defects.

**Patients and method**

**Surgical technique**

The design of the flap is standardized in a way to achieve two key goals. Firstly, the finger should be secured in a natural and comfortable position on the thenar region, which should maximally flex MCPJ and keep PIPJ flexion at 90° and DIPJ flexion at 0°. This position also allows maximal passive range of motion (PROM) of the finger after the flap inset. This ideal position of comfort is outlined by marking the edge of the fingertip defect with a marker pen, then flexing the finger to template the mark on the thenar region as shown in Figure 1.

Secondly, the flap must be orientated in a way to ensure adequate coverage of the defect. There are three technical points that must be taken note of to achieve a good coverage: 1) The flap must be designed and elevated taking into consideration the orientation and location of the defect; 2) The flap must be inset in a position of comfort, to prevent flap dehiscence; 3) The flap can be further customized during flap division in order to ensure complete coverage of the fingertip. We have described our technique in detail in the example below.

**Coverage of volar fingertip defect**

After debridement of the fingertip defect, the defect is outlined with a marker pen, and the flap is subsequently flexed naturally to template on the thenar region, the MCPJ is maximally flexed and PIPJ
is kept flexion at 90° and DIPJ is kept flexion at 0°. This is the final resting position of the finger as shown in Figure 2a.

The flap must be elevated in a way to ensure that the flap is inset in the position as we planned without displacement. To do so, a mirror image technique is being used. For the radial volar defect, a mirror image of the template is created on the ulnar side in order to elevate a radially based thenar flap. For the ulnar volar defect, a mirror image of the template is created on the radial side in order to elevate an ulnarily based thenar flap. The design of the donor site is marked out as shown in Figure 2b.

The three borders of the flap are incised and raised using diathermy to coagulate the blood vessels, while preserving the attachment of the subcutaneous tissue and fat to the dermis as shown in Figure 3. Care is taken to protect the neurovascular bundle when raising the flap. Once the flap is elevated and turned over, it should be able to fully cover the templated defect. The injured finger is flexed and the flap is ready to inset.

The distal edge of the flap should be sutured first to the proximal edge of the defect with a 3–0 prolene to against tension. The rest of the flap can then be comfortably insetted with prolene 5–0. The donor site can generally be closed primarily if the flap has been orientated carefully by suturing the opposite angles together as shown in Figure 4. It is important to ensure that there are no exposed raw areas as this allows for easier wound care and makes it easier for the patient to exercise before division.

Release of tourniquet to check the flap viability is unnecessary, as the blood supply to the thenar flap is always good. Bulky dressing is then applied to allow the finger to be more comfortably positioned. The flap is divided after three weeks.

**Coverage of dorsal fingertip defect**

For the dorsal defects, a mirror image is marked on the pulp and templated over the thenar region. It is then elevated simply as a proximally based flap.

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Figure 1. Illustration of thenar flap design.
Figure 2a. Defect is templated on the thenar region.

Post-operative care

Post-operatively, the patient’s dressing should be changed every three to five days and the patient should be encouraged to move his fingers actively as much as possible within the constraints of the dressing. After all the sutures are removed at two weeks postoperative, the wound is left exposed. During this period, we encourage the patient to passively range their fingers by holding the DIPJ, elevating and pressing the DIPJ to allow PIPJ up and down movement, pulling and pushing the DIPJ to allow MCPJ flexion and extension. Post-operatively, the MCPJ is only able to move slightly, but the PIPJ is able to move up to 40° with the assistance from thumb adduction and abduction movements as soon as the sutures are removed.

After one week of satisfactory finger mobilisation, the thenar flap can be divided. During division, the flap can still be modified or extended if the flap has dehisced or the defect is not fully covered during the initial surgery.

When the fingertip is covered by a broad based pedicle that it still attached to thenar eminence, the skin bridge is not long enough, and therefore the flap needs to be extended in order to fully cover the defect as shown in Figure 5. However, if the fingertip is well separated from the thenar eminence by a narrow skin bridge containing the pedicle, there will be no need for flap extension.

Results

From July 2018 to April 2019, a total of ten patients underwent thenar flap reconstruction of the fingertips. Details of the patients are summarised in Table 1. There were nine males and one female. The average age was 39 years, ranging from 19 to 71 years. In our study, other than the female who has Diabetes Mellitus, all other patients do not have any comorbidities. The flap dimensions ranged from 10 mm × 10 mm to 25 mm × 15 mm. All the flaps survived. One patient developed wound infection post division. All donor sites were closed primarily without the need for skin graft as shown in
Figure 2b. Create a mirror image of the template.

Table 1
Patients’ data

| No. | Age (years) | Gender | Location of fingertip defect | Finger | Flap Dimensions (mm) | Time to division (days) | Post op 1wk PIPj PROM | Post op 1wk PIPj AROM | Post op 3mth PIPj PROM | Post op 3mth PIPj AROM |
|-----|-------------|--------|-----------------------------|--------|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| 1   | 19          | Male   | Volar radial                | Index  | 20 × 15               | 17                     | 0–100                  | 20–100                  | 0–100                  | 0–100                  |
| 2   | 51          | Male   | Volar radial                | Index  | 25 × 15               | 21                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |
| 3   | 31          | Male   | Volar ulnar                 | Ring   | 20 × 15               | 24                     | 0–100                  | 10–100                 | 0–100                  | 0–100                  |
| 4   | 24          | Male   | Volar radial                | Index  | 20 × 10               | 24                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |
| 5   | 23          | Male   | Volar radial                | Ring   | 15 × 10               | 21                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |
| 6   | 14          | Male   | Volar ulnar                 | Ring   | 21 × 16               | 17                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |
| 7   | 48          | Male   | Volar ulnar                 | Ring   | 21 × 16               | 17                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |
| 8   | 34          | Male   | Dorsal                      | Ring   | 12 × 10               | 14                     | 0–100                  | 15–100                 | 0–100                  | 4–100                  |
| 9   | 60          | Male   | Volar                       | Middle | 20 × 15               | 16                     | 0–100                  | 10–100                 | 0–100                  | 10–100                 |
| 10  | 32          | Male   | Volar                       | Index  | 10 × 10               | 28                     | 0–100                  | 0–100                  | 0–100                  | 0–100                  |

*No.6 patient has wound infection post division, no post op 1 week measurement data.

Figure 6. The average follow up length of time was 5.4 month. All patients were able to flex their PIPj to 100° after division at one week. Four patients had 10 to 20° of extensor lag at the PIPj but PROM was full. It was noted that these four patients only started finger mobilization after flap division.

Discussion

The thenar flap has been used for more than 90 years. Various different designs have been described and the thenar flap has been proven to be a functional and aesthetically acceptable local hand flap. However, objective functional data following thenar flap reconstruction is not abundant in the
Figure 3. Elevation of a radially based thenar flap.

Figure 4. Donor site closed primarily by suturing the opposite angles together.
Figure 5. A thenar flap with a broad based pedicle.

Figure 6. 3 month after thenar flap, donor site fully recovered.
literature and pitfalls as well as contraindications of this flap have been hotly debated. In particular there has been concern about its use in the older population due to fears of causing PIPJ contracture. Another reason why the data has been conflicting is due to the lack of the standardization of the flap design as well as the aftercare and rehabilitation of the finger.

We have described a standardised technique that helps us to visualise the final outcome during the initial design of the thenar flap as well as during flap division. By using a marker to outline the defect on the thenar region after determining the position of comfort for the affected finger, the next step is to create a mirror image of the defect to elevate the flap. Hence the thenar flap can then be customized in such a way that the defect will be adequately covered, no matter the orientation of the fingertip defect.

We have divided the defects into three groups based on the location of the defect. For radial volar defects, the flap is radially based and elevated from the ulnar side. For ulnar volar defects, the flap is ulnarly based and elevated from radial side. For a pure volar defect, the flap can be radial, ulnar, proximally or distally based.

We have five patients who underwent flap division within three weeks, and five patients who underwent flap division after three weeks. In former group, three in five patients had 10 to 20° of extensor lag at first week postoperative, and two patients still had some extensor lag at three months postoperative. In the later group, one in five patients had 10° of extensor lag at first week postoperative, and none had residual extensor lag at three month postoperative. Early division did not result in better outcomes than late division.

To ensure complete coverage of the defect, precision in the division of the thenar flap is also important. Improper division of a broad based pedicle will create a new defect on the fingertip, and an unsatisfactory result.

The modified thenar flap can be done with a forearm tourniquet under a regional block and/or digital block. Prolonged immobilization of the PIPJ in a flexed posture can cause contracture. Prevention is better than treatment. Allowing even minimal glide of as little as 5 mm can translate to 40° gain in PIPJ motion by preventing adhesions. Early passive exercise of finger is started as soon as the sutures are removed till flap division to prevent PIPJ contracture.

We describe a technique that allows for customization of flap design based on the orientation of the defect, making it simpler and more replicable. We have also emphasized how care during the flap division can help prevent complications. Our modified thenar flap technique enable us to administer better soft tissue coverage, easier wound care and earlier mobilization as compared to a conventional thenar flap.

Declaration of Competing Interest

None declared.

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Ethical approval

Not required.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi: 10.1016/j.jpra.2021.01.010.
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