RESEARCH ARTICLE

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Modified Reverse Cross Finger Flap: Reticulodermo-Adipofascial Flap

ABSTRACT

Objective: The reverse cross finger flap is a modified crossed finger flap with the advantages of the heterodigital island flap. Local flap reconstruction techniques have been used predominantly to repair small to medium-sized finger defects. This flap is considered suitable for all fingers except the thumb. The subdermal plexus provides the main blood supply of this flap. The aim of this study is to present the characteristics and results of patients treated in our clinic.

Methods: In our clinic, 11 patients with exposed bone, tendon, nerve or vessels on the dorsum of the finger; skin and soft tissue defects; and the need for reconstruction after tumoral mass excision were retrospectively investigated with the 'Modified Reverse Cross Finger Flap: Reticulodermo-Adipofascial Flap' technique. Results were evaluated.

Results: The mean age of the patients was 57.2 years. 7 patients had a finger dorsal defect after trauma, 2 patients had a finger dorsal defect after tumoral mass excision, 1 patient had a finger dorsal defect after chronic wound excision, and 1 patient had a finger dorsal defect after burn scar revision. Modified Reticulodermo-Adipofascial Reverse Cross Finger Flap technique was applied to these defects. No flap loss was observed in any patient. No inclusion cyst was seen in the flap area. 2 patients had minimal, mild joint motion limitation at the distal interphalangeal joint. Wound site appearance and functional gain were acceptable and good.

Conclusions: We prepared a stronger flap by incorporating only the reticular dermis into the adipofascial tissue. We also prevented the damage of the subdermal vascular plexus by couring the reticular dermis. In previous applications, the design of the reverse cross finger flap was planned as dermoadipofascial after the epidermis was de-epithelialized or as adipofascial after the epidermis and dermis were de-epithelialized. This flap design prevents the formation of cysts originating from hair, oil and sweat glands. In addition, this flap design prevents cyst formation and contributes to the blood supply of the flap.

Keywords: Finger Dorsal Defect, Reverse Reticulodermo-Adipofascial, Cross Finger Flap.

Modifiye Ters Çapraz Parmak Flebi: Retikülodermo-Adipofasyal Flep

ÖZET

Amaç: Ters çapraz parmak flebi, heterodijital ada flebinin avantajlarına sahip modifiye edilmiş bir çapraz parmak flebidir. Lokal flep rekonstrüksiyon teknikleri, ağırlıklı olarak küçük ve orta boyuttaki parmak defektlerini onarmak için kullanılmıştır. Bu flebi başparmak hariç diğer parmaklar için uygun görülmüştür. Subdermal pleksus, bu flebin ana kanlanmasını sağlar. Bu çalışmanın amacı kliniğimizde tedavi edilen hastaların özellikerini ve sonuçlarını sunmaktır.

Yöntem: Kliniğimizde el parmak dorsumunda ekspoze kemik, tendon, sinir veya damarlar olan; cilt ve yumuşak doku defekti olan; tümöral kitle eksizyonu sonrası rekonstrüksiyon gereği olan ‘Modifiye Ters Çapraz Parmak Flebi: Retikülodermo-Adipofasyal Flep’ tekniği yapılan 11 hasta retrospektif olarak araştırıldı. Sonuçları değerlendirildi.

Bulgular: Hastaların yaş ortalamaları 57,2 idi. 7 Hastada travma sonrası el parmak dorsalinde defekt, 2 hastada tümöral kitle eksizyonu sonrası el parmak dorsalinde defekt, 1 hastada kronik yara eksizyonu sonrası el parmak dorsalinde defekt ve 1 hastada yanık skarı revizyonu sonrası el parmak dorsalinde defekti mevcut idi. Bu defektlere Modifiye Retikülodermo-Adipofasyal Ters Çapraz Parmak Flebi tekniği uygulandı. Hiçbir hastada flep kaybı görülmedi. Flep uygulanan bölgede inklüzyon kisti görülmedi. 2 hastada distal interfalangeal eklemde minimal, hafif eklem hareket kısıtlılığı mevcut idi. Yara yeri görünümü ve fonksiyonel kazanç kabul edilebilir ve iyi idi.

Sonuç: Sadece retiküler dermisi adipofasyal dokuya dahil ederek daha güçlü bir flep hazırlandı. Retiküler dermisi kouryarak subdermal vasküler pleksusun hasarlanmasını da önlemiş olduk. Daha önceki uygulamalarda ters çapraz parmak flebi tasarımı; epidermis de-epitelize edildikten sonera dermoadipofasyal şeklinde planlanmış yada epidermis ve dermis de-epitelize edildikten sonra adipofasyal şeklinde tasarlanmış. Bu flep dizaynı; kıl, yağ ve ter bezi kaynaklı kistlerinin oluşma ihtimalini engel olmaktır. Ayrıca bu flep dizaynı kist oluşumuna engel olurken flebin kanlanmasına da katkı sağlamaktır.

Anahtar Kelimeler: Parmak Dorsal Defekti, Ters Retikülodermo-Adipofasyal, Çapraz Parmak Flebi.

INTRODUCTION

Dorsal finger defects always pose a challenge for the reconstructive surgeon. Because there are not many regional options. Local flap reconstruction techniques have been used predominantly to close small and medium-sized finger defects (1).

Although various flaps have been described for adequate coverage of dorsal finger defects, these flaps may not result in cosmetic and functional satisfaction due to volume mismatch (2). Tube flaps harvested from the chest, abdomen, groin and forearm are reliable for adequate closure of dorsal finger wounds; however, these flaps will be bulky and offer poor cosmetic and functional results (3). To minimize the morbidity of the donor finger, the reverse cross finger flap was planned from the second, third, fourth and fifth fingers (2).

The reverse cross finger flap is a modified crossed finger flap that has the advantages of the heterodigital island flap (4). The skin connection helps to preserve the distal viability of the flap while reducing pedicle movement and preventing venous congestion (4,5). The flap is made to fit the boundaries of the functional phalanx unit exactly (4,6).

This flap is supplied by the branches of the dorsal digital arteries of the radial or ulnar side of the finger and the appropriate digital arteries. The dorsal digital artery cannot be used as the axial vessel of dorsal digital flaps due to its short diameter (1). In addition, the continuity of the digital artery is preserved. These vessels are known to be fixed on the proximal and middle phalanges. The subdermal plexus provides the main blood supply of this flap.

Indications for the reverse cross finger flap; reconstruction of the eponychial skin fold; coverage of an exposed extensor tendon near the interphalangeal joint (IP); reconstruction of exposed sterile matrix nail bed defects; covering a crushed, repaired or grafted extensor tendon without a paratenon; boutonniere deformity with poor quality skin over the proximal interphalangeal joint (PIP) after burn or avulsion injury; repair of the nail bed, germinal matrix and skin around the fingers after complete avulsion; and correcting the finger deformity in selected cases (7,8). This flap is also among the options after the excision of tumoral masses on the hand finger's dorsal surface. It should be noted that the hand is exposed to intense sun exposure, but the formation of basal cell carcinoma in the hand is relatively rare. (9).

Extensive dorsal skin loss and injuries to adjacent fingers constitute contraindications (7). Vasospastic conditions such as Raynaud disease, diabetes mellitus and Buerger disease may represent absolute contraindications (8). Pre-existing disability problems such as Dupuytren's contracture, rheumatoid arthritis and advanced age pose an increased risk for the outcome of the cross finger flap (8). The most basic prerequisite for soft tissue repair in the hand is to cleanse the wound from infection, remove all dead tissue and provide a stable skeletal structure (10). The dorsum of the finger contains a thin skin with a small amount of subcutaneous tissue underneath (11,4). The flap is planned to be approximately 1 cm longer and approximately 4 to 5 mm wider than the defect (7,2). Better cosmetic results are achieved by covering the flap with full-thickness skin grafts instead of split-thickness skin grafts (11).

The basic principle is to preserve the length of the finger, provide a sensory skin cover and provide functional improvement as much as possible (2). One of the most important criteria is whether the bone is exposed or not (2). The superiority of this flap has been proven in terms of sensitivity, durability, efficiency and reliability in terms of returning the patient to their profession (8).

The aim of this study is to present the characteristics and results of patients treated in our clinic.

MATERIAL AND METHODS

Our study was approved by Tekirdağ Namık Kemal University Non-Interventional Clinical Research Ethics Committee. Between 01.06.2017-30.10.2024, 11 patients who applied to our clinic and underwent 'Modified Reverse Cross Finger Flap: Reticulodermo-Adipofascial Flap' technique were retrospectively analyzed. Patients with open wounds, defects, tumoral masses and defects after mass excision with exposed bone, tendon, nerve or vessels on the dorsum of the finger and who underwent 'Modified Reverse Cross Finger Flap: Reticulodermo-Adipofascial Flap' technique in our clinic were examined. The number of patients who underwent this technique, gender, dominant hand, occupation, smoking, defect causative factor, defect localization, defect size, graft donor area, flap loss, joint function loss, inclusion cyst formation in the flap and wound appearance are indicated in the table. This flap was compared with previous methods. We also presented two case examples from our case series.

Surgical Technique: This flap includes all tissues from the reticular dermis to the paratenon of the extensor tendons. De-epithelialization is one of the most important technical details of this flap. During de-epithelialization, we de-epithelialized the epidermis and the superficial papillary dermis together. We included the reticular dermis, which is in the deep plane, in the adipofascial tissue. In other words, we designed a reticulodermo-adipofascial flap.

Case 1: A 68-year-old male patient had a 2x3 cm mass on the dorsal side of the middle phalanx of the right hand 2nd finger and a 1x1 cm hard hyperkeratotic mass fixed to the base on the DIPJ. The masses were benign and fixed to the base. The case was started under regional

anesthesia and tourniquet with loop guidance. The masses were resected with sufficient margins to include the tendon sheath. A 3x4 cm flap was designed from the dorsal side of the 3rd finger. The skin including the epidermis and papillary dermis was de-epithelialized. The reticular dermis is preserved. An incision was made for the reticuloadipofascial flap. The flap was incised on the defect side. The reticuloadipofascial flap was elevated in a way that the paratenon of the extensor tendon was protected. It was transferred to the defect area by rotating it 180 degrees. A tourniquet was opened. Bleeding control was performed. A full-thickness skin graft wider than the defect area was taken from the medial aspect of the right arm to cover the 2nd and 3rd fingers. The graft was de-fatted. Holes were opened in the graft. The graft was adapted to cover both the flap donor area and the transferred flap. Both fingers were fixed to each other with fixation sutures from the proximal and distal sides. A dressing with plenty of furacyn ointment was applied instead of a tie-over dressing. A short arm splint was applied. The dressing was removed on the 5th postoperative day. It was observed that the graft was adapted and the flap circulation was good. Flap separation was performed under local anesthesia on the 20th postoperative day. Wound follow-up was performed for another week. Hand rehabilitation was started at the end of the 4th postoperative week. Our case example and results are shown in figure 1.a-j.

Figure 1.a. Right hand 2nd finger middle phalanx dorsal 2x3 cm mass and 1x1 cm hard hyperkeratotic base fixed mass on DIPJ.

Figure 1.b. Exposed tendon and bone after mass excision.

Figure 1.c. 3x4 cm flap design from dorsal 3rd finger; skin de-epidelization including epidermis and papillary dermis.

Figure 1.d. Reticuloadifascial flap elevation.

Figure 1.e. Transfer of reticulodermo-adifascial flap to defect area by rotating it 180 degrees.

Figure 1.f. Repair of flap donor area and flap surface with full thickness skin graft.

Figure 1.g. Postoperative 3rd week view.

Figure 1.h. View after separation of flap in 2nd session operation.

Figure 1.i. Dorsal view of the fingers 1 month after flap separation.

Figure 1.j. Volar view of the fingers 1 month after flap separation.

Case 2: A 43-year-old male patient had a crush and defective injury to his right hand fingers with a high-energy cutting tool. There was a 2x4 cm defect on the dorsal side of the middle phalanx of the 2nd finger, including the nail bed. The nail bed, bone tissue and extensor tendon were exposed. The extensor tendon was damaged. The defect extended to the DIPJ. There was skin damage on the dorso-ulnar side of the proximal phalanx of the 1st finger, nail and nail bed damage on the 3rd finger, and nail and nail bed damage in addition to the skin defect on the DIPJ and radial side of the distal phalanx of the 4th finger. There was no injury on the dorsal middle phalanx of the 3rd finger. Reconstruction was planned for the 2x4 cm defect including the dorsal middle phalanx of the 2nd finger and the nail bed. The case was started under regional anesthesia and tourniquet with loop guidance. The damaged extensor tendon was repaired. A 3x5 cm flap was designed from the dorsal side of the 3rd finger. The skin including the epidermis and papillary dermis was de-epithelialized. The reticular dermis is preserved. An incision was made for the reticuloadipofascial flap. The defect side of the flap was incised. The reticuloadipofascial flap was elevated in a way that the paratenon of the extensor tendon was protected. It was transferred to the defect area by rotating it 180 degrees. The tourniquet was released. Bleeding control was performed. A full thickness skin graft wider than the defect area was taken from the medial right arm to cover the 2nd and 3rd fingers. The graft was de-fatted. Holes were opened in the graft. The graft was adapted to cover both the flap donor area and the transferred flap. Both fingers were fixed to each other with fixation sutures from the proximal and distal sides. A generous furacyn ointment dressing was applied instead of a tie-over dressing. A short arm splint was applied. The dressing was removed on the 5th postoperative day. It was observed that the graft had adapted and the flap circulation was good. Flap separation was performed under local anesthesia on the 20th postoperative day. Wound follow-up was performed for another week. Hand rehabilitation was started at the end of the 4th postoperative week. Our case example and results are shown in figure 2.a-j.

Figure 2.a. 2. A 2x4 cm defect including the nail bed on the dorsal side of the middle phalanx of the

2nd finger; Skin damage on the dorso-ulnar side of the proximal phalanx of the 1st finger; Nail and nail bed damage on the 3rd finger; Skin defect and nail and nail bed damage on the radial side of the DIPJ and distal phalanx of the 4th finger.

Figure 2.b. 2. A 2x4 cm defect including the nail bed on the dorsal side of the middle phalanx of the 2nd finger; Nail bed, bone tissue and extensor tendon exposed; Extensor tendon damaged; The defect extends to the DIPJ.

Figure 2.c. 3. A 3x5 cm flap design from the dorsal side of the 3rd finger; skin de-epidelization including epidermis and papillary dermis.

Figure 2.d. Elevation of reticuloadipfascial flap.

Figure 2.e. Transfer of reticulodermo-adifascial flap to defect area by rotating it 180 degrees.

Figure 2.f. Repair of flap donor area and flap surface with full thickness skin graft.

Figure 2.g. Postoperative 3rd week view.

Figure 2.h. View after separation of flap in 2nd session operation.

Figure 2.i. Dorsal view of fingers 1 month after flap separation.

Figure 2.j. Volar view of fingers 1 month after flap separation.

RESULTS

The characteristics of the patients, defect location, causes, size and postoperative findings are given in table 1. No flap loss was observed in any patient. No inclusion cyst was observed in the flap application area. There was minimal, mild joint movement restriction in DIPJ in 2 patients. Wound appearance and functional gain were acceptable and good.

Table 1. Characteristics of patients, defect location, causes, size and postoperative findings.

Number of patients	11
Gender	Female:3 Male:8
Dominant hand	Right hand:10 Left hand:1
Occupation	Farmer:7 Manual worker:2 Civil servant:1 Student:1
Smoking	Smoking + :8 Smoking - :3
Defect causative factor	Trauma:7 Tumoral mass:2 Chronic wound:1 Burn scar:1
Defect localization	Right hand 2nd finger middle phalanx dorsum:4 Right hand 2nd finger distal phalanx dorsum and DIPJ:2 Right hand 3rd finger middle phalanx dorsum:2 Right hand 4th finger middle phalanx dorsum:1 Left hand 2nd finger middle phalanx dorsum:1 Left hand 3rd finger middle phalanx dorsum and DIPJ:1
Defect size	Smallest: 2x2 cm Largest: 3x4 cm
Graft donor area	Right arm medial: 9 Left arm medial: 2
Flap loss	none
Joint function loss	2 Patients have slight limitation in DIPJ
Inclusion cyst formation in the flap	No
Wound appearance	Good

DISCUSSION

The reverse de-epithelialized crossed finger flap, a modification of the traditional crossed finger flap, provides good coverage. It has been found to be a reliable option for reconstructing dorsal defects of the finger. The reverse cross finger flap is also a very useful flap for open wounds on the dorsum of the finger, especially in the presence of exposed bone and tendon; and for nail bed defects that cannot be closed with other techniques.

The cross finger flap was first described by Gurdinin in 1950 and by Pangman in 1951 as a soft tissue cover for covering defects on the volar surfaces of single fingers (12).

Atasoy reported four patients with nail bed defects treated with axial pattern adipofascial flaps

after the reverse dermis flap described by Pakiam (2). Voche and Merle described the axial pattern homodigital subcutaneous flap for the treatment of dorsal finger defects (13). The most important disadvantages of this procedure are the distortion of the pedicle after transposition of the flap over the defect and the fact that it can only cover two thirds of the defect. The axial patterned adipofascial cross finger flap described by El-Khatib has the disadvantages of long dissection time and sacrificing the digital artery (14). Al-Qattan modified the existing technique by turning the flap proximally from the same finger (15).

Elhoda infiltrated isotonic saline for easy dissection of the flap (4). We did not find this necessary since we easily dissected with a loop.

A separation surgery should be performed on the 10th to 14th postoperative day; thus, joint stiffness, which is an important complication, will be prevented (16).

In the reverse cross finger flap technique described by Atasoy; the skin is elevated as a full-thickness skin flap. Then, the adipofascial tissue is transferred to the defect area as a reverse cross finger flap. The elevated full-thickness skin flap is adapted same place.

It is difficult to de-epithelialize only the epidermis and there is a possibility that the epidermis may remain in the flap. The reason we included the papillary dermis in de-epithelialization is to prevent the formation of hair, sebaceous and sweat gland cysts. By including the reticular dermis in the flap, we have prepared a stronger flap. We have also contributed to the blood supply of the flap from the deep dermal plexus. By keeping the reticular dermis intact, we have also prevented damage to the subdermal vascular plexus.

In previous applications, the reverse cross finger flap was designed as dermoadipofascial by de-epithelializing the epidermis or adipofascial by de-epithelializing the epidermis and dermis. Our aim in designing this flap is to prevent the formation of hair, sebaceous and sweat gland cysts and to contribute to the blood supply of the flap while preventing this.

As Karthikeyan stated, the possibility of inclusion cysts after the flap transferred to the defect area after de-epithelialization is a disadvantage (12). We aimed to prevent this disadvantage by modifying this flap and including only the reticular dermis in the adipofascial tissue. He drew attention to the possibility of partial necrosis of the dermal flap and the fact that graft harvesting was not optimum over the adipofascial flap (12). In the study conducted by Coşkunfırat, the skin flap was elevated in a zigzag shape, then the adipofascial flap was elevated and transferred to the defect area (17). They did not provide any information about the viability of the skin flaps elevated in a zigzag shape. Therefore, we did not use a dermal flap. We also did not use the skin graft taken from the flap. We covered the flap donor area and the flap with a healthy full-thickness skin graft of the same properties taken from the medial arm.

The primary goal of soft tissue reconstruction in the hand is to restore normal or near-normal motion of the fingers. This requires thin, flexible skin that allows the underlying tendons to glide freely. Although an adipofascial flap with skin graft is a thin flap, authors have obtained poor results in adipofascial flap reconstructions in the hand (10). The skin graft contracts significantly, limiting movement and eliminating the perceived advantages of the thin flap. To prevent this and to prevent the scarring effect of the skin graft on the adipofascial flap, we left the reticular dermis over the adipofascial tissue intact. We reduced secondary contraction by repairing the donor area and the flap with a full-thickness skin graft. This contributed to our functional gain in the finger.

CONCLUSION

Modified reverse cross finger flap: The reticulodermo-adipofascial flap is a satisfactory option for repairing defects on the dorsal aspect of the finger with the advantages of minimal donor site deformity, flexibility, ease, feasibility, a functional finger joint, ideal blood supply, flap design in correct plan and prevention of cystic lesions.

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