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Littler Flap: A reliable option in soft tissue defects of different fingers

Littler Flep: Farklı parmakların yumuşak doku defektlerinde güvenilir bir seçenek

Ali Rıza Yıldırım, Murat İğde, Mehmet Tapan, Mehmet Onur Öztürk, Burak Yaşar, Ramazan Erkin Ünlü

Department of Plastic, Reconstructive and Aesthetic Surgery, Ankara Numune Training and Research Hospital, Ankara
Corresponding author: Ali Rıza Yıldırım, Department of Plastic, Reconstructive and Aesthetic Surgery, Ankara Numune Training and Research Hospital, Altındag/Ankara
E-mail: prsary86@gmail.com
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SUMMARY

Objective: Finger soft tissue defects are common following trauma, burn, and contracture release. Heterodigital neurovascular island flap is one of the important flaps used for this purpose. However, it is generally used for the repair of pulp defects involving first finger, it is also useful for defects involving other fingers. In this study, we presented our clinical findings on the use of and outcomes associated with Littler flap in the reconstruction of soft tissue defects involving not only first finger, but also different fingers.

Method: This descriptive study included 13 patients (9 males, 4 females) who were treated with a neurovascular island flap for different finger soft tissue defect between August 2012 and June 2014. Tissue defect was located the thumb in 4 patients, index finger in 4 patients, middle finger in 3 patients and ring finger in 2 patients. We evaluated sensibility and range of motion of the injured finger and donor finger.

Results: In the study group, all flaps survived completely. At a mean follow-up of 12 months, the results of the donor and reconstructed fingers regarding range of motion showed that all patients achieved excellent or good results. The donor-site morbidity was accepted. The patients rarely complained of pain or the cold intolerance of the flap.

Conclusions: The most important reason for the preference given to this flap in the reconstruction of finger defects is a reliable option due to constant pedicle for flap viability, single stage procedure, early mobilization of the hand, good functional and cosmetic result. Our opinion is that a littler flap should be used in different finger defects since it is highly useful and reliable in terms of flap complications and donor field morbidities.

Keywords : finger injuries, island flaps , pedicled flap , soft tissue injuries

ÖZET

Amaç: Travma, yanık ve kontraktür açılmasını takiben parmak yumuşak doku defektleri sıktır. Heterodijital nörovasküler ada flebi, bu amaçla kullanılan önemli fleplerden biridir. Genellikle birinci parmak pulpa defektlerinin tamirinde kullanılmasına rağmen diğer parmaklarda oluşan defektleri için de kullanışlı bir seçenektir. Bu çalışmada sadece 1.parmakta değil farklı parmak yumuşak doku defektlerinin rekonstrüksiyonunda littler flebi kullanımı ve sonuçları sunulmuştur.

Yöntem: Bu tanımlayıcı çalışmada, Ağustos 2012- Haziran 2014 tarihleri arasında nörovasküler ada flebi ile parmak yumuşak doku defekti rekonstrüksiyonu uygulanan 13 hasta (9 erkek, 4 kadın) çalışmaya dahil edilmiştir. Doku defekti, 4 hastanın başparmağında, 4 hastanın işaret parmağında, 3 hastanın orta parmağında, 2 hastanın da yüzük parmağında yer almaktaydı. Donor ve yaralanan parmaklar, hareket açıklığı ve duyu açısından değerlendirildi.

Bulgular: Bu çalışma grubunda, fleplerin tamamı yaşadı. Ortalama 12 ay takipte, donor ve rekonstrükte edilen parmakların hareket açıklığına göre sonuçları tüm hastalarda mükemmel yada iyi olarak gösterildi. Donor saha morbiditesi kabul edilebilirdi. Hastalar, nadiren ağrı ve soğuk intoleransından yakınmaktaydı.

Sonuç: Parmak defektlerinin rekonstrüksiyonunda bu flebin tercih edilmesinin en önemli nedeni, flep yaşayabilirliği için sabit pedikülü olması, tek aşamalı prosedür olması, elin erken hareketi, iyi fonksiyonel ve kozmetik sonuç nedeniyle uygun bir seçenektir. Bizim düşüncemiz, littler flep, donor saha morbiditesi ve flep komplikasyonları açısından son derece kullanışlı ve uygun olmasından dolayı, farklı parmak defektlerinde kullanılmalıdır.

Anahtar sözcükler: parmak yaralanmaları, pediküllü flep, yumuşak doku yaralanmaları

INTRODUCTION

Finger soft tissue defects are common following trauma, burns, and contracture release, as well as due to secondary causes after a primary operation. Various local pedicled flaps or island flaps are preferred for the reconstruction of finger soft tissue defects. Early stage reconstruction is very important to prevent complications such as stiff finger and flexion contracture due to scar formation.[1] A flap with sensory capacity are particularly preferable in defects involving finger pulp. Furthermore, in defects accompanying injuries to some important anatomic structures such as tendon, vessel, or nerve, it is important to cover the defect as soon as possible and at a single stage, begin rehabilitation, and shorten time to return work.

Neurovascular island flap was first used by Bunnel in 1931 to reconstruct a defect in a thumb amputation stump using a neurovascular flap with sensory capacity elevated from the adjacent finger. Starting from the modifications made by Moberg and Littler, neurovascular island flaps for thumb defects have begun to be elevated from the ulnar half of the fourth finger (Figure 1).[2] In this study, we presented our clinical results of the Littler flap which was used for thumb, index finger, middle finger and ring finger.

Figure 1. A sample case of classic littler flap. **a)** An exposing bone defect of the first finger. Flap was harvested from the ulnar side of ring finger. **b)** Dorsal view postoperative at 3 month, **c)** Volar view postoperative at 3 month

MATERIAL AND METHODS

This descriptive study included all patients (9 males, 4 females) who were treated with a neurovascular island flap for a finger soft tissue defect between August 2012 and June 2014. The mean age of the study population was 37 (20-67) years. Thirteen finger injuries were treated in 13 patients. The injury was a sharp penetrating object injury in 4 patients, crush injury in 6 patients, burn injury in 2 patients, and a defect remaining after contracture release in a patient **(**Table 1**).**

Tissue defect was located the thumb in 4 patients, index finger in 4 patients, middle finger in 3 patients, and ring finger in 2 patients (Figure 2). Ring finger was preferred as the donor area for flaps to be used for soft tissue defects in 10 patients and middle finger in additional 3 patients. Ten flaps were elevated from the lateral aspect of the ulnar side of ring finger whereas flaps were elevated from the lateral aspect of the ulnar side of middle finger due to a scar in ring finger from a previous operation or injury in 3 patients. Mean defect size was 2.3 cm^2 (1.5-3.2 cm^2). The longitudinal and transverse axis of the planned flaps were measured 2.1 cm (1.5-3 cm) and 1.7 cm (1.1-2.4), respectively.

The operations were performed under general anesthesia or axillary block using a pneumatic tourniquet. The flap was elevated from ulnar aspect of the ring or middle finger. The flap extends from finger tip to the proximal interphalangeal (PIP) joint. Flap elevation proceeds from distal to proximal, pedicled on the corresponding neurovascular bundle. A zigzag insicion was performed from distal palmar crease to proximal of the flap. The perivascular fatty tissue was preserved for better venous drainage. The flaps were transferred to recipient area a tunnelized pedicle all patients. Donor area was primarily reconstructed in 3 patients and closed with a full-thickness skin graft in 10 patients. The patients were monitored for flap circulation for 3 (2-6) days after the operation. They were then followed regularly for about a mean follow-up of 12 (9-16) months.

The following parameters were assessed: active range of motion of the distal interphalangeal joint and proximal interphalangeal joint for both the reconstructed and donor fingers, sensation of the flap and donor site. The range of motion of the proximal and distal interphalangeal joints of the reconstructed and donor fingers were measured by a goniometer at postoperative follow-up. The motion arcs of the fingers were compared with the normal hand. The sensibility of the flaps and donor sites was measured with the Semmes-Weinstein monofilament test and the static 2-point discrimination (2PD) test as well as cold intolerance test.[3,4] Two point discrimination measurements were done according to the Modified Criteria of the American Society for Surgery of the Hand (excellent < 6 mm, good 6-10 mm, moderate 11-15 mm, and poor > 15 mm). Cold intolerance in both injured and normal finger was categorized as mild, moderate, severe, and very severe (0-25, 26-50, 51-75, 76-100, respectively), based on the Cold Intolerance Severity Score Questionnaire.[5,6]

The pain of the reconstructed finger and the donor site was given subjectively by the patient using the visual analogue scale, which ranged from 0 to 10 (0 - no pain and 10 - worst pain).

According to the Michigan Hand Outcomes Questionnaire, patients reported their satisfaction with the appearance of the injured hand The questions were based on a five-point response scale.[7] Descriptive statistics analysis were performed using the statistical software SPSS version 16.0 software (SPSS Inc, Chicago, III, USA). Data were expressed as frequency.

Table 1. Patients and characteristics.

Case No.	Age	Sex	Injury Finger	Donor finger	Complication	Follow-up (mo)
1	20	M	Distal phalanx of the thumb	Ring	-	11
2	28	M	Middle phalanx of the index	Middle	-	13
3	23	M	Distal phalanx of the index	Ring	Venous congestion	10
4	31	F	Proximal phalanx of the middle	Ring	-	10
5	27	M	Distal phalanx of the index	Ring	Venous congestion	12
6	30	F	Distal phalanx of the thumb	Ring	-	15
7	44	F	Middle phalanx of the index	Ring	-	16
8	52	M	Middle phalanx of the middle	Ring	-	12
9	56	M	Distal phalanx of the thumb	Ring	-	14
10	40	F	Proximal phalanx of the ring	Middle	Venous congestion	10
11	32	M	Distal phalanx of the ring	Middle	-	12
12	67	M	Distal phalanx of the thumb	Ring	-	9
13	33	M	Distal phalanx of the middle	Ring	-	12

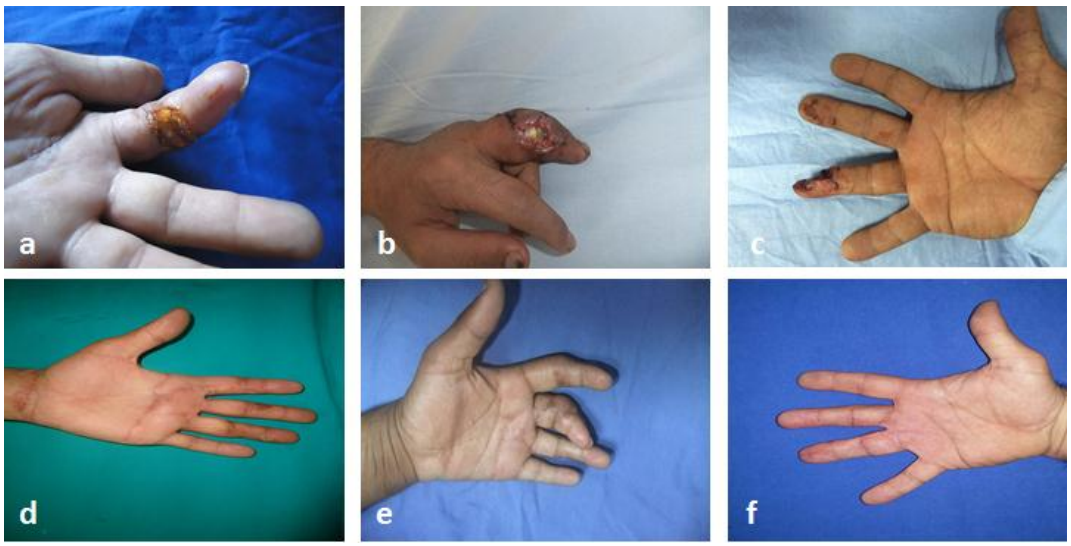

Figure 2. Reconstruction of different finger defect with littler flap
a-c) Soft tissue defect examples for index, middle, ring fingers, respectively
d-f) Post operative results of second, middle, ring finger flaps, respectively

RESULTS

All flaps survived completely without partial or total necrosis. During the postoperative monitorization of flap, 3 (%23) patients had problems related to venous insufficiency/congestion; flap circulation, however, recovered in all at follow-up. Wound infection was not observed. Donor-finger full-thickness skin grafting was successful in all cases. No major scar contractures were recorded in any patient.

At a mean follow-up of 12 months (range 9–16 months), the mean static 2PD and Semmes-Weinstein monofilament scores on the flaps were 8.6 mm (range, 7–11 mm) and 4.15 (range, 3.61–4.56), respectively. Based on the modified American Society for Surgery of the Hand guidelines for stratification of s2PD, 12 (% 92.3) of 13 flaps achieved good s2PD results and 1 (%7.7) flaps obtained moderate 2PD results. According to the Cold Intolerance Severity Score, 11 (%84.6) reconstructed fingers had no cold intolerance and 2 (% 16.4) experienced mild cold intolerance. Based on the VAS, 10 (%77) fingers had no pain, and 3 (%23) experienced mild pain. Based on the Michigan Hand Outcomes Questionnaire, 9 (%69.2) patients were strongly satisfied (score 5) and 4 (%30.8) were satisfied (score 4) with functional recovery of the reconstructed finger (Table 2).

Table 2. Questionaries and scores of the patients.

CASE	ROM (DIP/PIP) (degrees)	FLAP s2PD (mm)	FLAP SWM	CISS	Pain	Appearance (MHQ)
1	90/45	7	3.61	0	0	5
2	100/55	8	4.31	0	0	5
3	90/50	7	4.31	20	4	4
4	110/60	10	4.56	0	0	4
5	100/60	9	4.31	0	0	5
6	100/60	8	3.61	0	0	5
7	70/40	9	4.31	0	0	5
8	90/55	10	4.56	10	2	4
9	110/70	10	4.31	0	2	5
10	90/50	11	4.56	0	0	5
11	95/50	7	3.61	0	0	5
12	100/50	9	4.31	0	0	4
13	110/50	8	3.61	0	0	5
mean		8.6	4.15	2.3	0.6	4.6

2PD : 2-point discrimination test
SWM: Semmes-Weinstein Monofilament test
CISS: Cold intolerance severity score

On the donor sites, the mean static 2PD and Semmes-Weinstein monofilament scores were was 11.2 mm (range, 9–14 mm) and 4.35 (range, 4.17–4.56), respectively. 10 (%77) donor fingers had no cold intolerance and 3 (%23) experienced mild cold intolerance. According to the VAS, 10 (%77) fingers had no pain on the donor sites, and 3 (%23) experienced mild donor pain. The range of motion of the donor fingers was similar to that of the opposite sides (Table 3).

Table 3. The range of motion of the donor and opposite fingers

CASE	ROM (DIP/PIP) (degrees) Donor Finger	Opposite side	Donor site s 2PD (mm)	SWM	CISS	Pain
1	60/100	60/110	10	4.17	0	0
2	70/90	75/95	12	4.56	0	0
3	80/100	85/115	11	4.17	10	2
4	85/90	90/95	10	4.17	0	0
5	70/95	75/105	13	4.56	0	0
6	85/90	90/115	13	4.56	0	2
7	75/100	75/105	12	4.17	0	0
8	80/90	90/95	10	4.17	10	0
9	80/95	90/115	9	4.17	0	0
10	75/100	75/105	10	4.56	0	0
11	85/90	90/95	13	4.56	10	2
12	75/100	85/105	14	4.56	0	0
13	75/90	90/95	9	4.17	0	0
mean			11.2	4.35	2.3	0.4

2PD : 2-point discrimination test
SWM: Semmes-Weinstein Monofilament test
CISS: Cold intolerance severity score

DISCUSSION

Many surgical techniques including homodigital, heterodigital, and microsurgical operations have been defined for the reconstruction of finger defects. Homodigital flaps are indicated for smaller defects .[7,8] Among these, the flag flap described by Iselin in 1973 for small-sized defects, and the palmar digital artery based lateral/palmar reverse flow island flap described by Oberlin in 1988 can solve problems in injured fingers. [9-10] Their usage is limited in local transposition, rotation, and extension flaps. Some other options are axial pattern transposition flap, arterialized lateral finger flap, and homodigital subcutaneous flap, although the application of these flaps is also limited because there must be sufficient amount of tissue around the defect and they necessitate the sacrification of palmar digital artery.[11-13] Moberg flap, one of the flaps used for thumb reconstruction, is used for defects smaller than 1.5 cm in diameter although it has certain disadvantages such as flexion contractures and joint stiffness. In larger defects, heterodigital flaps such as cross-finger flap and heterodigital neurovascular island flaps (Littler, Foucher flap etc.) are widely used [14,15]

Despite being one of the primary options for the reconstruction of especially the finger tip defects, cross-finger flap is not always feasible due to simultaneous injury to adjacent fingers or limited expected cosmetic harm in a single finger.[16,17] Although the advantage of covering the existing defect particularly with cross-finger and interpolation flap, it has an important disadvantage of frozen joint as a result of finger immobilization for about 2 weeks, particularly in older patients.

The reconstruction of finger soft tissue defects is challenging in terms of functional and aesthetic outcomes.

Abdominal interpolation or distant pedicled flaps are aesthetically flawed due to a bulkier tissue they create, when compared to heterodigital island flaps. They requıre more than one operation. Moreover, The free flaps are not an easy option, either, because the recipient vessels may be unhealthy due to surrounding infection or trauma. However, these techniques usually require a two-team approach, microsurgical technique, long operating time and carry a risk of anastomotic failure[18].

Among the heterodigital flap options, the Foucher flap, developed by Foucher and Braun in 1979, is a first dorsal metacarpal artery based neurovascular island flap, but it has important disadvantages such as a lower 2 point discrimination, cold intolerance, hyperesthesia, difficult cortical adaptation, and limited flap size. It is also probable that patients suffer a venous return anomaly due to pedicular dissections[19-20]

We preferred this flap because of a higher chance of survival than other conventional flaps, a lower rate of donor field comorbidities such as flexion contracture or joint stiffness, defect reconstruction without the need of finger shortening, and a shorter time to return to work after a single-stage procedure.

The most common postoperative complication of heterodigital neurovascular island flap is early venous congestion. Utmost care should be paid and the concomitant vein accompanying the artery should not be severed when dissecting the neurovascular pedicle. No flap loss was observed despite early venous congestion in 3 patients enrolled in the present study.

Rose modified the Littler neurovascular island flap to include only the digital artery and venae comitantes at its pedicle, preserving the digital nerve in the donor digit.[20] We haven't preferred this option because this procedure requıre to dissection pedıcle so high risk for flap viability

Heterodigital neurovascular island flap was classically described by Littler for pulp defects of thumb.[21] However, the feasibility of this flap in different finger defects was shown in our study. It was observed that this flap can be safely and readily used due to its longer rotation arch in volar or dorsal finger defects. The flap is reliable with consistent viability so that all Littler flaps survived completely. It provides similar tissue to that lost in terms of color and texture .The technique is simple and reproducible. Major disadvantage, resulting in sensory loss at the donor site but minimizing donor morbidity, the flap is harvested from the ulnar border, thus preserving the radial part that is in direct opposition with the thumb.[22]

However, a hypothenar island flap was preferred over Littler flap in fifth finger defects because of a simpler and more rapid dissection of a hypothenar island flap. Kojima et al. reported a clinical trial of vascularized flap transfers from the hypothenar eminence of the hand with successful results.[23]

The results of the donor and reconstructed fingers regarding range of motion showed that all patients achieved excellent or good results. The most important reason for the preference given to this flap in the reconstruction of finger defects is an excellent aesthetic outcome coupled with highly favorable joint mobility due to early mobilization as a result of a single-stage procedure. Therefore, patients returned to their activities after a short period of time. The absence of hypo-hyperesthesia problems in recipient finger is another advantage. Our opinion is that a littler flap should be used in different finger defects since it is highly useful and reliable in terms of flap complications and donor field morbidities.

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