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Evaluation of Dorsal Reverse Adipofascial Flap for Fingertip Amputation Reconstruction

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Abstract

Background & Objectives: Fingertip injuries are very frequent among hand injuries; these injuries need to be carefully addressed as it has an important role in fine motor activity and delicate sensation. The aim is to assess the outcome by using the dorsal reverse adipofascial flap in the reconstruction of fingertip amputations at the level of the nail fold.

Methods: This prospective case series study was conducted in Rizgary Teaching and Rozhawa Emergency Hospital in Erbil city/Iraq from June 2018 to June 2020.Twenty patients sustained fingertip amputations at the level of the nail fold and underwent reconstruction of their fingertips using the dorsal reverse adipofascial flap. We evaluated the fingertip appearance, The function of the proximal interphalangeal joint and distal interphalangeal joint, donor site scar, and patient`s satisfaction.

Results : The mean age ± SD of patients was 29.5 ± 8.5 years, the median was 28 years, and the age range was 18 -48 years. The most common injured finger was the ring (35%), Type of injury was mostly by a sharp object (40%). only one patient (5%) was not satisfied, (10) ten patients (50%) were satisfied, and 9 (45%) were highly satisfied. There was a statically significant association between patients' satisfaction and the presence of complications.

Conclusion: The dorsal reverse adipofascial flap is effective in the reconstruction of traumatic fingertip amputations at the level of the nail fold with consistent aesthetic and functional results.

Key words: Dorsal reverse adipofacial flap ,Fingertip amputations, Nail fold.

Introduction

Fingertip injuries are very frequent injuries among hand injuries, these injuries need to be carefully addressed as it has an important role in fine motor activity and delicate sensation.[1]The reconstruction of fingertip amputations is challenging in balancing a functional and cosmetically acceptable result; ensuring the least possible difficulties for the patients. The dorsal reverse adipofascial flap (DRAF) is indicated for the reconstruction of amputations that are dorsal oblique or transverse through the level of the nail fold, an additional advantage of DRAF is being a one-stage reconstruction procedure, easy to perform, no involvement of the adjacent unharmed fingers, no involvement of the volar skin for better finger activity and grasp function, and no dysesthesia or cold intolerance with aesthetically acceptable results and stable flap cover of the reconstructed fingertips.[2] Reconstruction of fingertip amputations gives better results in terms of function if flaps are to be used[3]. Stable pulp achieved by flap reconstruction provides a constant interface for object manipulation.[4] Usually speaking trauma to the hand, especially that involving the fingertip, occurs mostly in the young age group with a low socioeconomic status who require, due to

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their general financial capabilities and work, to be treated with a simple procedure, short downtime, and early mobilization.[5] The DRAF is used for the reconstruction of Allen's type 4 fingertip injury when there is loss of lunula, distal phalanx, pulp, and nail.[6] The fingertip injures which are not treated by flaps, may cause fingertip discomfort, hypersensitivity, cold intolerance, and/or pain of which result in making the patient exclude the injured finger from daily activities.[7] Whenever fingertip replantation is not an option for reconstruction whether for logistic, anatomic, or patient factors, hence, reconstruction by flap will provide a pleasing and stabilized fingertip.[8] The amputations that are left to heal by secondary intention will eventually end with a contracted scar that is hypersensitive and painful, this can be avoided with appropriate flap reconstruction.[9] This study aims to evaluate the outcome of the reconstruction of fingertip amputations utilizing DRAF. The objective of this study is to assess results according to: functional result (distal and proximal phalangeal joints mobility), aesthetic result (preservation of finger length and appearance), complications and satisfaction rate.

Materials and methods

This is a prospective study conducted in Rizgary Hospital and the emergency department of Rozhawa Emergency Hospital in the period between June 2018 until June 2020.The study included 20 patients who presented with fingertip amputations and had satisfied the study inclusion criteria. The age of the patients included in the study ranged from 18 to 48 years of age; the mean follow-up period was for a minimum of 6 months duration in Rizgary Teaching Hospital. The study individuals had acute amputations except for one, in whom a previous attempt to salvage a partial amputation ended in stump necrosis a few days later. All patients who underwent fingertip amputation reconstruction were evaluated clinically and photographically before and after the operation. The exclusion criteria were children, non-compliant patients, Associated proximal injuries on the same hand, Hepatitis B virus-positive patients, Previous scar or peripheral vascular disease in the finger. The (DRAF) flap described here was used only for amputations at the level of the nail fold, from approximately the lunula to the proximal nail matrix (Figure 1). This flap is based on the dorsal arterial branches that originate from the volar digital arteries just distal to the distal interphalangeal joint (DIP).

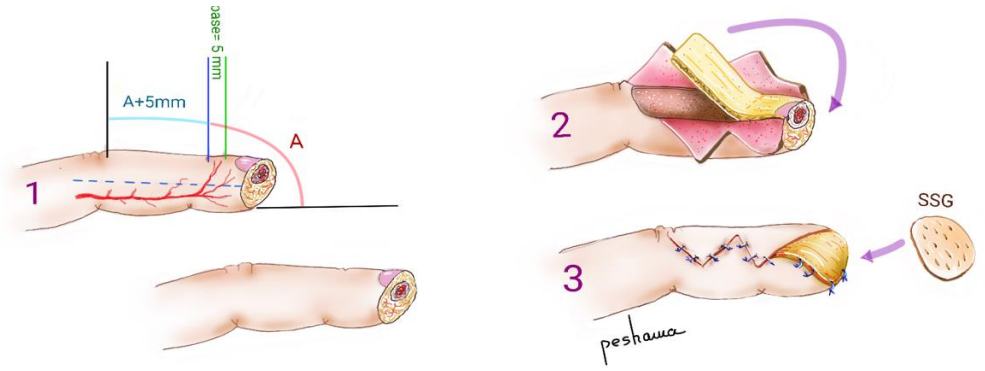

Figure (1): Shows the details of the DRAF.

(1) The vascular basis of the flap, the measurement of the flap with the 5 mm base of the flap (proximal to the germinal matrix). (2) the M incision, elevation of the skin flaps and using the adipofascial flap as a turnover flap leaving an intact paratenon to cover the exposed bone. (3) sutured skin flaps, adipofascial flap and applied split-thickness skin graft.

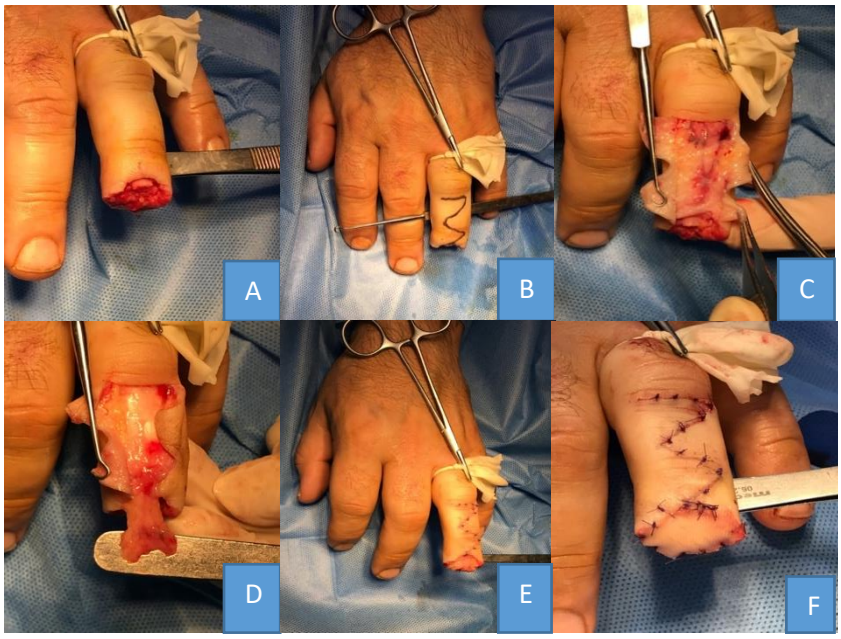

Figure (2): DRAF procedure.

A. fingertip amputation at the level of the nail fold of the left ring finger. B. the M marking for dissection of the DRAF flap. C. elevation of the skin flaps. D. separation of the flap with attention to preserving the extensor tendon paratenon. E. inset of the flap to cover the exposed bone and sutured skin flaps. F. flap is covered with a split-thickness skin graft taken from the hypothenar region.The flap is composed of only the adipofascial tissue over the middle phalanx of the injured finger; which is turned over to cover the fingertip defect and then covered with a split-thickness skin graft taken from the hypothenar region. Furthermore, the 5 mm of the base adjacent to the matrix, is marked on the dorsal surface of the middle phalanx from the mid-lateral line ulnarly to the mid-lateral line radially. An “M” incision is made from the level of the nail fold to the proximal edge of the flap marked “A”, whereas care should be taken to preserve 5 mm of the distal base of attachment proximal to the nail matrix, to maintain the integrity of the distal dorsal branches of the digital arteries to this flap. Sutures are not placed in the distal turned-over end of the flap, and there is no need to stretch the flap beyond the extent needed to cover bone alone. These measures avoid undue flap tension. One also must be cautious with the donor site, the skin flaps are raised at the level of the dermis, but the integrity of the subdermal vascular plexus must be preserved and paratenon must be maintained on the extensor mechanism (Figure 2). Judicious postoperative splinting enables wound healing to occur. All flaps utilized in this study have survived completely, and the patients continue to use their fingertips as before the amputation injury. The study protocol was approved by the ethics committee of the Kurdistan Board of Medical Specialties. Informed consent was

obtained from all patients.Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 26). Fisher's exact test was used (instead of the Chi square test) when the expected frequency (value) was less than 5 of more than 20% of the cells of the table. A p value of ≤ 0.05 was considered as statistically significant.

Results

This research studies a total of 20 patients. Their mean age ± SD was 29.5 ± 8.5 years, the median was 28 years, and the age range was 18 -48 years. The largest proportion (45%) of the sample were aged 25-34 years. The majority (95%) of the sample were males. The most common injured fingers were the ring (35%), index (30%), and the middle finger (30%), while the little finger was injured in one patient (5%) only. Regarding the type of injury, it was mostly (40%) by a sharp object. The right side was affected in 75% of the cases Table (1).

Table (1): Basic characteristics of patients.

	No.	(%)
Age (years)		
< 25	6	(30.0)
25-34	9	(45.0)
≥ 35	5	(25.0)
Mean (±SD)	29.5	(±8.5)
Gender		
Male	19	(95.0)
Female	1	(5.0)
Injured finger		
Index	6	(30.0)
Middle	6	(30.0)
Ring	7	(35.0)
Little	1	(5.0)
Type of injury		
Blunt trauma	5	(25.0)
Sharp injury	8	(40.0)
Rotatory machine	6	(30.0)
Fingertip necrosis	1	(5.0)
Side		
Right	15	(75.0)
Left	5	(25.0)
Total	20	(100.0)

Four patients developed mild complications, two (10%) developed nail spicules, and there was a skin graft loss in the other 2 (10%) patients Figure (3).

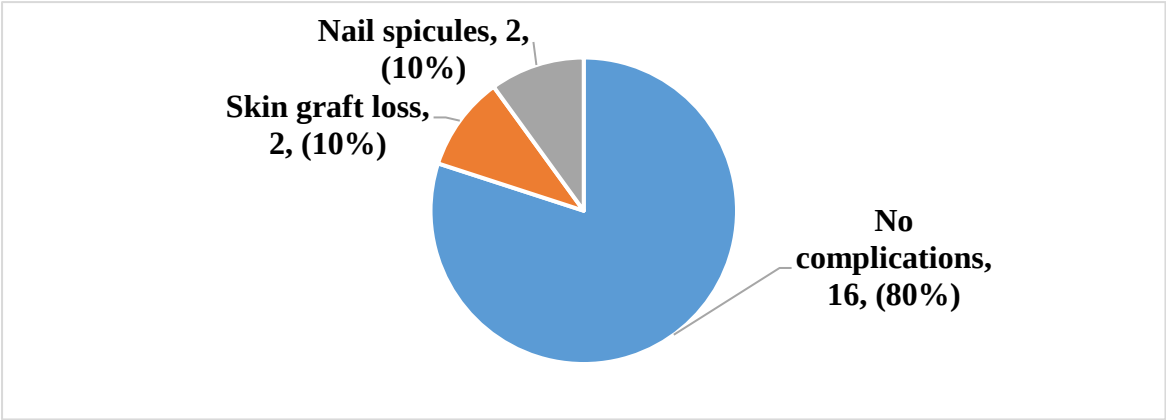

Figure (3): Incidence of complications in the studied sample.

It is evident in Table 2 that only one patient (5%) was not satisfied, 10 (50%) were satisfied, and 9 (45%) were highly satisfied. No significant association was detected between patients' satisfaction with age (p = 0.442) and gender (p = 0.500).

Table (2): Patients' satisfaction by age and gender.

	Highly satisfied		Satisfied		Unsatisfied		
	No.	(%)	No.	(%)	No.	(%)	p value
Age							
< 25	2	(33.3)	4	(66.7)	0	(0.0)	
25-34	3	(33.3)	5	(55.6)	1	(11.1)	
≥ 35	4	(80.0)	1	(20.0)	0	(0.0)	0.442*
Gender							
Male	8	(42.1)	10	(52.6)	1	(5.3)	
Female	1	(100.0)	0	(0.0)	0	(0.0)	0.500*
Total	9	(45.0)	10	(50.0)	1	(5.0)	

*By Fisher's exact test.

The surgeons were either satisfied (55%) or highly satisfied (45%) with the outcome of the operation. Only one patient (5%) was unsatisfied with the outcome, 10 patients (50%) were satisfied, and the rest (45%) were highly satisfied, as presented in Table 3. There was a significant association between patients' satisfaction and the presence of complications (p = 0.042), where it is evident that this unsatisfied patient had a complication, as presented in Table 3. No significant association was detected between surgeons' satisfaction with the complications (p = 0.094) Table (3).

Table (3): Patients and surgeons' satisfaction by presence of complications.

	Complications						
	Absent		Present		Total		
	No.	(%)	No.	(%)	No.	(%)	p value
Patients' satisfaction							
Highly satisfied	9	(56.3)	0	(0.0)	9	(45.0)	

Satisfied	7	(43.8)	3	(75.0)	10	(50.0)	
Unsatisfied	0	(0.0)	1	(25.0)	1	(5.0)	0.042*
Surgeon's satisfaction							
Highly satisfied	9	(56.3)	0	(0.0	9	(45.0)	
Satisfied	7	(43.8)	4	(100.0)	11	(55.0)	0.094*
Total	16	(100.0)	4	(100.0)	20	(100.0)	

*By Fisher's exact test.

The flaps utilized in the reconstruction of the fingertips under this study survived completely. Donor sites healed uneventfully (Figure 4). There were two cases of partial graft loss that were treated conservatively with topical antibiotics ointment and daily dressing changes. Two of the cases developed nail spicules as a minor complication which was treated by excision of the spicules under local anesthesia.The function (range of motion) of the proximal interphalangeal joint (PIP) and distal interphalangeal joint (DIP) in the reconstructed fingers was comparable to the contralateral side (Figure 5). All patients returned to their previous occupations between 30 to 45 days. The operation did not impair function and day-to-day activities. The appearance of the fingertip was cosmetically accepted.

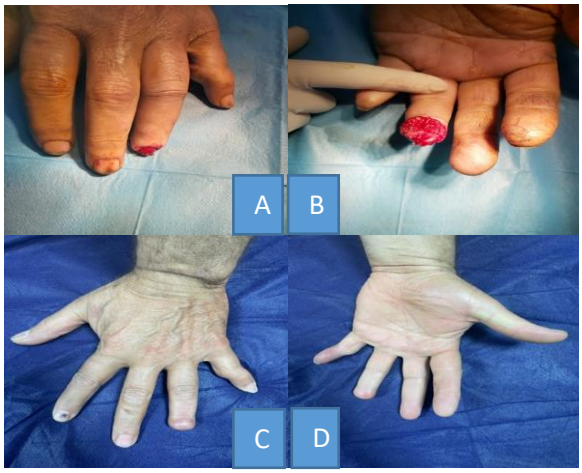

Figure (4): Result of reconstruction using DRAF. A. and B. preoperative C. and D. post-operative result (1 year).

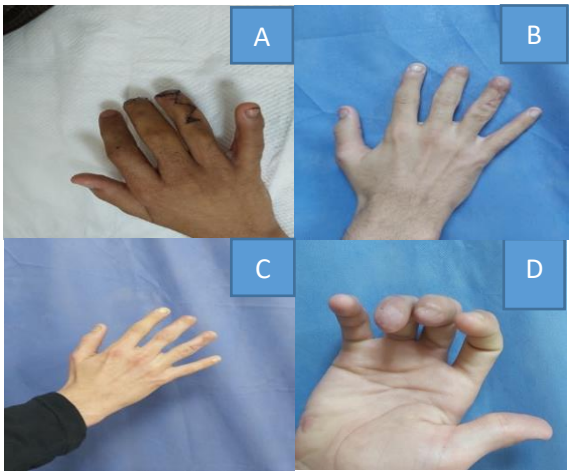

Figure (5): Result of reconstruction using DRAF (ring finger). A. 1 week. B. 3months. C. and D. 6 months postoperatively. Soft pulp, flat scar and fully functioning DIP and PIP joints.

Discussion

Exposed bone, tendons, and nerves or soft tissue deficiency that affect the process of healing with secondary intention or skin grafting indicate the use of flaps for reconstruction. The relatively long time needed for immobilization of fingers when using regional or distant flaps affect the mobility of finger joints and lead to stiffness of the affected fingers, fingertip amputations have a high impact on the function of the hand so the reconstruction of these amputations needs a strong and

stable interface to cover the bone defects and gives near normal appearance of the fingertip without jeopardizing the adjacent fingers.[5]With this in mind we chose the dorsal reverse adipofascial flap for the reconstruction of acute fingertip amputations and we evaluated the outcome of it to serve the purpose of this study.The most common injured finger was the ring (7 cases), index (6 cases), and the middle finger (6 cases), while the little finger was injured in one patient who had fingertip necrosis five days after an attempt to reattaching the amputated part. Regarding the type of injury, it was mostly by a sharp object. The right side was affected in 15 of the cases. No patient had major complications like DRAF flap of skin flaps necrosis. The flaps utilized in the reconstruction of the fingertips in this study were totally survived. Donor sites healed uneventfully. Four patients developed mild complications (Figure 3), two developed nail spicules which were treated by excision of the spicules under local anesthesia, and there was a skin graft loss in another 2 patients that were treated conservatively with topical antibiotics ointment and daily dressing changes. only one patient with high expectations was not satisfied who had a minor complication (partial graft loss) that was treated conservatively, 10 (Ten) were satisfied, and 9 were highly satisfied. There was a significant association between patients' satisfaction and the presence of complications (Table 3). No significant association was detected between patients' satisfaction, with age (p = 0.442) and gender (p = 0.500) (Table 2). The surgeons were either satisfied or highly satisfied with the outcome of the operation as presented in No significant association was detected between surgeons' satisfaction with the complications (p = 0.094).The function (range of motion) of the proximal interphalangeal joint (PIP) and distal interphalangeal joint (DIP) in the reconstructed fingers was comparable to the contralateral side. All patients returned to their previous occupations between 30 to 45 days. The operation did not impair function and day-to-day activities. The appearance of the fingertip was cosmetically accepted.Usually, the amputations at the level of nail fold cannot be reconstructed by local flaps like Kutler V-Y flap or Atasoy V advancement flap.[10]While the cross-finger flap has the disadvantage of immobilization of the neighboring fingers with resultant damage to the joints.[11] In some studies, researchers debated the direct relationship between finger joints complications and patients aged more than 30 years in flap procedures requiring immobilization for a specific period of time[12]. The DRAF has the advantages of easy flap dissection, short recovery time, early mobilization, flap donor being in the same injured finger without involving other unharmed fingers., no decrease in the range of motion in the distal and proximal phalangeal joints, and a relatively fast return of the patients to their normal life activities and jobs.[5] Dimitrios et. al used inner forearm skin as a donor site for the split-thickness skin graft, in our study we used a split-thickness skin graft harvested from the hypothenar region for the resemblance to the fingertip pulp skin, its ease of harvest, and its requirement of a relatively shorter time to heal with an inconspicuous scar

Conclusion

Fingertip amputations that are treated improperly may lead to complications such as poor appearance, cold intolerance, and tenderness. In this study, we preview the importance of the DRAF that provides the perpetuation of digital length with sufficient padding of soft tissues, offers fine hairless skin, avoids uncomfortable immobilization, preserves the volume of the pulp, finger function, and shortens the hospital stay. For traumatic fingertip amputation, this flap delivers consistent

aesthetic and functional results. We recommend more comparative researches be done on a larger sample of cases to furthermore investigate the leverage of this flap.

Conflicts of interest

There were no conflicts of interest.

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