

Workhorse Flaps for Management of Soft Tissue Defects of the Dorsum of the Hand

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ABSTRACT

Background: The dorsum of the hand is a very specialized region with thin and fragile skin characterized by poor subcutaneous tissue.

Aim and Objectives: The work aimed to introduce methods of reconstruction of the soft tissue defects of the dorsum of the hand and wrist with exposed tendons, joints, nerves, and bones and compare these methods for each region.

Patients and Methods: This prospective clinical study was carried out on 30 patients who presented with soft tissue defects of the dorsum of the hand and exposed vital structures. Patients were treated with dorsum hand reconstruction using different pedicle flaps, either local, regional, or distant flaps, from October 2018 to March 2021. Patients will be selected from the Emergency Unit of The Plastic Surgery Department, Beni-Suef University and Beni-Suef Medical Insurance Hospital.

Results: Patient satisfaction ranged from 70% to 97%, and the mean patient satisfaction (Mean \pm standard deviation) was 86.73 ± 7.08 .

Conclusion: There are multiple options available for the reconstruction of soft tissue defects of the dorsum of the hand. The main goal of reconstruction is to provide thin, pliable skin that permits mobility. The reconstructive strategy depends on the location and size of the defect, the presence of concomitant digital defects, the need for staged procedures, and available resources.

Key Words: Dorsum – Hand – Flap – Reconstruction – Soft tissue defects.

Disclosure: No conflict of interest.

Ethical Committee: The study protocol was approved by the Institutional Human Ethical Committee of the Faculty of Medicine, Beni-Suef University, and Beni-Suef Insurance Hospital.

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INTRODUCTION

The hand is the bodily component used most frequently in daily life and is also the most delicate. Physical dysfunction from an injured hand is likely to occur, as well as aesthetic harm and psychological stress [1].

The dorsum of the hand is a highly specialized area with thin, delicate skin that is poorly developed subcutaneous tissue beneath the surface. The dorsal side of the hand is usually vulnerable to many sorts of injuries, exposing tendons and bone (crush, degloving, hot pressing, friction, etc.) [2].

These vital tissues are frequently exposed without a significant amount of vascularized soft tissue covering them, making them susceptible to desiccation and infection when the ensuing wound cannot be primarily closed [3].

Additionally, the vascularity of exposed bone, tendon, or cartilage is insufficient to sustain a granulation layer for re-epithelialization or neovascularization, which is necessary for the survival of skin grafts [4].

The idea of the functional aesthetic components and subunits of the hand combines what the mind imagines with what is present (or, in most cases, with what is absent), giving the surgeon a guide for choosing the reconstruction functional and aesthetic [5].

Scars that form due to hand soft-tissue coverage can be hidden or camouflaged within the limits of the hand's functional aesthetic units and subunits by matching the color, texture, soft-tissue volume, symmetry, and donor-recipient tissue interface.

The surgeon should also consider the unique patient variances by giving the patient a soft-tissue cover that matches their opposite, "regular," hand [5].

The therapy of complicated hand wounds provides a challenging task for the reconstructive surgeon. Due to these problems with reconstruction, complex hand wounds are frequently closed with local, regional, and free flaps [3].

PATIENTS AND METHODS

Thirty patients with exposed critical structures with soft tissue defects on the dorsal aspect of the hand participated in this prospective clinical study. Patients were treated with dorsum hand reconstruction using different pedicle flaps, either local, regional or distant flaps, from October 2018 to March 2021. Patients will be selected from the Emergency Unit of The Plastic Surgery Department, Beni-Suef University and Beni-Suef Medical Insurance Hospital.

Informed approval was obtained from the candidates after they were provided adequate information about the study (the study's characters, profits, and possible adverse consequences). The study protocol was approved by an Institutional Human Ethical Committee of the Faculty of Medicine, Beni-Suef University, and Beni-Suef Insurance Hospital.

Inclusion criteria: The patients' ages ranged from 2 to 60 years, traumatic injuries to the hand (e.g., motor car accident, treatment for severe burns is either debriding the wound or operating to break the scar's contracture), and both genders included.

Exclusion criteria: Patient receiving radio or chemotherapy, patients who are seriously affected in their ability to participate in this trial, e.g., patient with a history of mental illness or who has any medical condition (renal, hepatic, hematological, neurological, or immunological) that would prevent them from participating in the study.

Study design: Initial study information was given to the patients on whether to participate in the study was made or not. We obtained the following information: Full history taking to exclude the previous exclusion criteria in selected cases. The thorough investigation includes routine laboratory investigation, ECG and chest X-ray, preoperative medical fitness, and vascular investigation if a perforator flap is selected or suspected vascular injury (Duplex, doppler, C.T angiography). Preoperative photography was taken for all patients.

Preoperative injection of broad-spectrum I.V. antibiotics before tourniquet application.

Informed consent: Each patient signed a written informed permission form and was aware of the study's goal. The Ethics Committee of the Hospital district where the study was conducted granted permission for the study to be carried out.

Surgical technique: Only after the wound has been cleaned, all dead tissue has been excised, and there is a stable skeletal foundation can definitive reconstructive techniques be performed. The next stage is the choice of the flap to employ for wound covering. Obliterating dead areas (with relation to infectious risk), promoting healing of the wound with the restoration of lymphatic and venous circulation, and offering covering that glides for tendons and muscles are the goals of good coverage.

Postoperative care: Positioning of the patient: All patients were asked to elevate their upper limbs after surgery (to decrease postoperative pain, avoid or minimize edema, increase venous return, and avoid flap congestion). Sequential clinical examination of the flap for arterial insufficiency and venous congestion by: Color, temperature, tissue turgor, capillary return, and bleeding on pinprick.

Adequate hydration of the patient to minimize vascular spasms. I.V. antibiotics and analgesics. Proper postoperative physiotherapy.

Postoperative follow-up: Regular follow-up was scheduled for every patient. Immediate, early, and late complications were recorded. Flap failures, infections, partial loss of flap, donor-site problems, and the requirement for further revisions were all evaluated outcomes with at least six months of follow-up.

Follow-up assessment: Aesthetic evaluation at follow-up by VAS score (Visual Analog Scale, 0-10), where 0 represents not satisfied and ten represents very satisfied, was used to evaluate candidate satisfaction with the aesthetic appearance of the recipient site and donor. An instrument that can be used in questionnaires is (VAS) score, which is a psychometric response scale. Patients indicate their position along a continuous line between two endpoints to indicate their level of pleasure while responding to a VAS item.

The final functional outcome and residual disability were assessed objectively and recorded.

Statistical analysis: The data were analyzed using SPSS 22, a Windows version of the statistical software package SPSS. The variables were de-

scribed as follows: Quantitative variables were described using mean, SD, minimum, maximum, and range statistics. Numbers (No.) and percentile (Pct.) descriptions were used for qualitative variables (percent).

RESULTS

The patients' ages ranged from 6 to 75 years, and the mean age (Mean \pm standard deviation) was 23.7 ± 14.69 years. Table (1).

According to the causes of dorsum hand defects, five cases were due to burning, two were due to chronic ulcers, one was due to electrical burns, and twenty-two were due to trauma. Table (2).

Regarding the site of injury, twelve patients (40%) suffered from a dorsum hand injury and crushed, mutilated hand, ten (33.3%) patients with the dorsum of thumb and fingers, and eight (26.7%) patients experienced 1st web of a hand injury. Table (3).

As regard to types of flaps in our: Five (16.7%) patients with Radial forearm flap, five (16.7%) patients with Radial artery perforator flap, 4 (13.3%) with Anterior interosseous flap, 4 (13.3%) patients with posterior interosseous artery flap, 4 (13.3%) patients Abdominal flap, 3 (10%) patients Groin flap, 3 (10%) patient with Posterior interosseous flap and two (6.7%) patients with Quaba Flap (dorsal metacarpal Artery flap), Table (4).

Follow-up duration ranges from 3-8 months, and the mean follow-up duration (Mean \pm standard deviation) was 5.57 ± 1.25 . Patient satisfaction ranged from 70% to 97%, and the mean patient satisfaction (Mean \pm standard deviation) was 86.73 ± 7.08 . Table (5).

When comparing the complications with a different type of each flap, Dorsum of Hand & Crushed mutilated hand: Patients with Radial forearm flap showed no complications in 2 patients, Mild infection in one patient, partial graft loss in one patient, and Partial venous congestion in one patient. Patients with Groin flap showed partial graft loss in two patients and Partial venous congestion with Fungal infection in one patient. Abdominal flap patients had no complications, graft loss in one patient, bulky flap in one patient, and graft loss in one patient.

1st web of the hand and Dorsum of the thumb injury: Patients with radial artery perforator flap showed no complication in one patient, mild infec-

tion in one patient, mixed infection + bulky flap in one patient, and superficial venous congestion in 2 patients. Patients with posterior interosseous flap showed no complications in 2 patients and mild infection in one patient.

Dorsum of the fingers: Patients with anterior interosseous flap showed mild infection in two patients, and Ischemia in one patient didn't cover all defects in one patient. Patients with Quaba Flap (1st dorsal metacarpal Artery flap) showed Partial venous congestion in one patient and mild infection in one patient.

Table (1): Shows age distribution in this study.

Age (years)	Mean \pm SD	Minimum	Maximum
	23.7 ± 14.69	6	57

Table (2): Shows the etiology of hand defect.

Etiology	Burn	5 (16.7%)
	Chronic Ulcer	2 (6.7%)
	Electric burn	1 (3.3%)
	Trauma	22 (73.3%)

Table (3): Show the site of injury.

Wound site	Dorsum of Hand & Crushed mutilated hand	12 (40%)
	1 st web of the hand	8 (26.7%)
	Dorsum of thumb and fingers	10 (33.3%)

Table (4): Flap type in the studied patients.

Flap type	Dorsal interosseous artery flap	4 (13.3%)
	Abdominal flap	4 (13.3%)
	Anterior interosseous flap	4 (13.3%)
	Groin flap	3 (10%)
	Posterior interosseous flap	3 (10%)
	Quaba Flap (1 st dorsal metacarpal Art flap)	2 (6.7%)
	Radial artery Perforator flap	5 (16.7%)
	Radial forearm flap	5 (16.7%)

Table (5): Postoperative follow-up of the studied patients.

	Mean \pm SD	Minimum	Maximum
Follow-up duration (months)	5.57 ± 1.25	3	8
Patient Satisfaction	86.73 ± 7.08	70	97

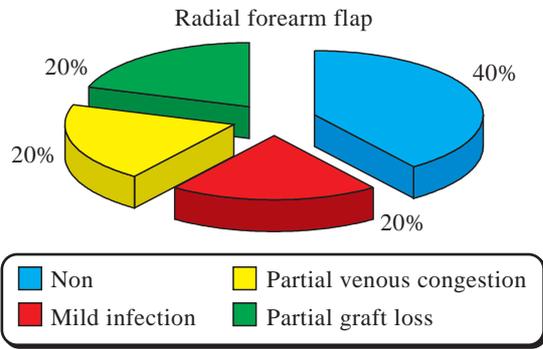


Fig. (1): Pie chart shows the outcome of radial forearm flap.

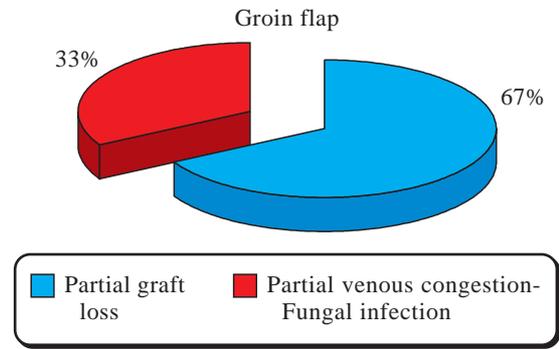


Fig. (2): Pie chart shows the outcome of groin flap.

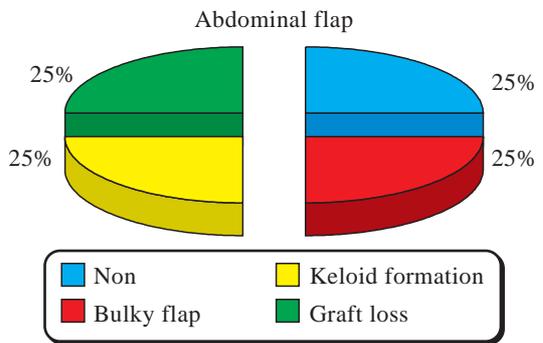


Fig. (3): Pie chart shows the outcome of the abdominal flap.

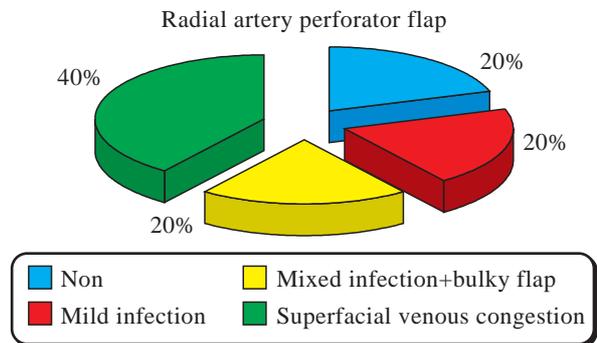


Fig. (4): Pie chart show outcome of radial artery perforator flap.

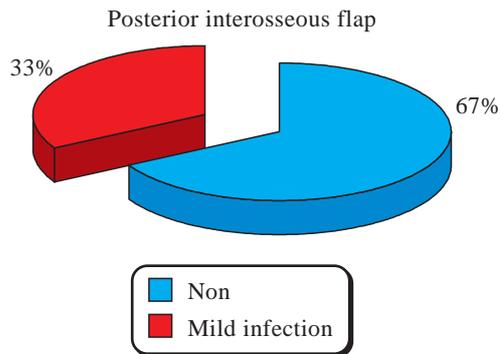


Fig. (5): Pie chart shows the outcome of the posterior interosseous flap.

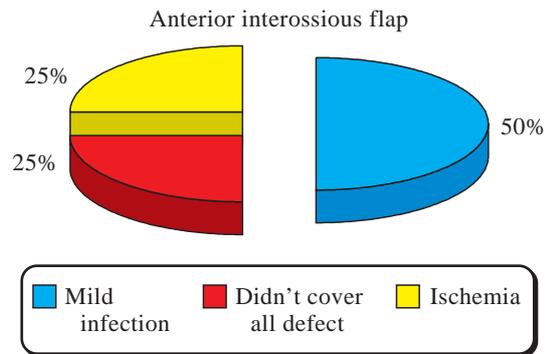


Fig. (6): Pie chart shows the outcome of anterior interosseous flap.

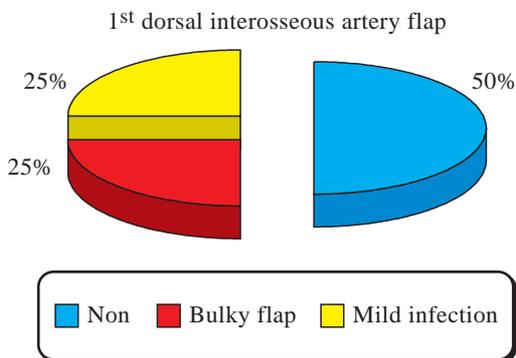


Fig. (7): Pie chart shows the outcome of 1st dorsal interosseous artery flap.

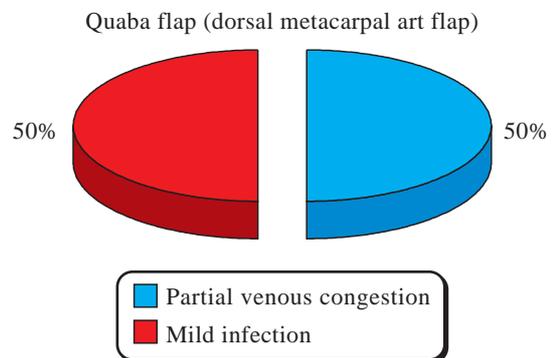


Fig. (8): Pie chart shows the outcome of quaba flap.

Case Presentation

Case (1): Radial forearm flap for reconstructing Skin loss of dorsum of the right hand and tendon injury after motorcar accident in Female patient, 43 years old.



(A): Preoperative.



(B): Intra-operative: After Debridement and tendon graft



(C): Planning of Radial forearm flap.



(D): Flap harvest and Elevation.



(E): Flap rotation and vascular bundle mobilization.



(F): One week postoperative.

(G): One month postoperative.



Case (2): Post interosseous a. Flap for reconstructing post burn contracture of left hand and fingers in Male patient, 12 years old.



(A): Preoperative and Flap planning.



(B): Intra-Operative after flap mobilization.

(C): Early one week postoperative.



Case (3): Abdominal flap for reconstructing post-traumatic skin loss of dorsum of a right index in Male patient, 38 years old.



(A): Flap design and Elevation.



(B): Covering the defect with a flap.

(C): One-week post-operative after flap separation.



DISCUSSION

Due to the scarcity of acceptable donor sites for repairing these intricate lesions, soft tissue covering the upper extremities remains difficult. Skin grafts may result in an unattractive cosmetic outcome at the recipient location and cannot reliably cover essential structures [6].

In this study sample of 30 patients with dorsal hand, injuries were included. The patient's age ranges from 6 to 75 years. Twenty male patients, and ten females patients. Regarding the etiology of the dorsum of the hand injury, 22 of these patients were caused by Trauma, five patients experienced a burn, two patients were caused by chronic ulcers, and only one patient had an electrical burn. Only three patients had DM and hypertension, and the rest had no medical conditions. Follow-up duration ranges from 3-8 months.

In 2010 Gavaskar [7] A.S. evaluated fifty-two patients with complex post-traumatic defects in the soft tissue of the hand from 2003 to 2005. Of these fifty-two cases, 32 underwent reconstruction using the posterior interosseous artery flap. Twenty-eight patients were male, and four were female. Thirty-eight years old on average (with a range of 18 to 64). The patients were monitored for an average of four years (ranging from three to five years). The etiology in 19 patients (industrial and farmyard injuries) and Thirteen patients (high-speed road traffic accidents) was occupational injury.

All the patients in our study had soft tissue defects on the dorsum of the hand. Wound size ranges from (1.2 x 2.5) to (9x 12) (cm).

According to the injury site, patients were divided into three main groups. Twelve patients suffered from a dorsum hand injury and crushed, mutilated hand, ten patients with Dorsum of the fingers, and eight patients experienced Dorsum of the thumb and 1st web of hand injury.

In our study, patients with Dorsum of Hand injury & crushed, mutilated hands were treated with Radial forearm flap, Groin flap, and abdominal flap.

In our study, Patients with Radial forearm flap showed no complications in 2 patients, Mild infection in one patient, partial graft loss in one patient, and partial venous congestion in one patient.

Our results align with a prior study, which found that the distally based axial pattern radial forearm flap is dependable, simple to perform, and

a good indicator for both minor and major hand deformities [8].

With satisfactory cosmetic outcomes and a low incidence of complications, the distally based radial forearm flap continues to be the go-to technique for reconstructing hand soft tissue abnormalities. (Wael, 2015).

Regarding our study, we have three complicated cases (10%) with abdominal flap, graft loss in one patient, bulky flap in one patient, and graft loss in one patient.

In 2018 Naalla et al. [9] underwent reconstruction with pedicled flaps in 165 patients for the dorsum of hand, wrist, and thumb soft tissue defects. Marginal flap necrosis, which required only local wound care in thirty two patients (15%), partial flap necrosis, which required flap advancement or an extra flap in fifteen patients (7%) and surgical site infection, which required resuturing in five patients (2.4%) were the complications that were noted. Total flap necrosis also noted in four patients (2%).

Drawbacks of this flap are a two-stage procedure, bulkiness and thickness of the flap necessitating defatting, and a long period of immobilization during inset of the flap [10].

In our study, patients with 1st web of hand injury and dorsum of the thumb injury were treated with Radial artery Perforator flap, 1st dorsal interosseous artery flap, and Posterior interosseous flap.

Patients with a Posterior interosseous flap showed no complications in 2 patients and Mild infection in one patient.

In 2010 Gavaskar et al. [7] Used the posterior interosseous artery flap, and soft tissue repair was performed on 32 cases. Two patients had minor necrosis of the flap's distal portion, perhaps from a tight closure, but no extra surgical treatments were necessary. Two individuals experienced a mild superficial infection treated with local wound care and parenteral antibiotics to clear up.

According to our study, we have two complicated cases (6.7%) in Patients with Quaba Flap (dorsal metacarpal Artery flap). One case complicated by Partial venous congestion and one case complicated by a mild infection.

In 2020 Karjalainen, T. and Jokihaara J [11] review a meta-analysis on 1069 DMCA, dorsal metacarpal artery-based flap; show Donor Site complication about 0.2%, infection of flap 0.3%, so the total percent of complication 0.5%.

Patients with Anterior interosseous showed Mild infection in two patients, and Ischemia in one patient didn't cover the entire defect in one patient.

According to other research, an anterior interosseous artery perforator flap can successfully treat minor to moderate-sized lesions. The anterior interosseous artery perforator flap is not recommended for patients with repeated extremity fractures, degloving injuries, or trauma zones in the vicinity of the perforator [12].

One of the major disadvantages of the Anterior Interosseous Artery flap is its unsightly donor site over the exposed forearm [13].

The average rate of problems following hand flap surgery was 5.4 percent in the published data, with vascular compromise accounting for two-thirds of all difficulties [11].

With perforator-based flaps or reverse flow flaps, vascular compromise most frequently occurs. These flaps' perfusion is precarious and their ability to maintain venous return is easily impaired [11].

Conclusion:

Various options are available for reconstructing soft tissue deformities on the hand's dorsum. The main goal of reconstruction is to create flexible, thin skin that allows for motion. The location and magnitude of the defect, the presence of concurrent digital faults, the requirement for staged operations, and the availability of resources all affect the reconstructive technique.

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