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Reconstruction of Post-Traumatic Soft Tissue Defects of the Hand and Fingers: Experience of the Department of Plastic and Burn Surgery a Series of 53 Cases

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Abstract: **Case Report**

The hands are essential organs, playing a crucial role in various functions such as sensation, motor skills (prehension), and communication. They are also a major symbol in our social interactions. Always visible, the hands contribute to the harmony of the body not only through their function but also through their form, size, and appearance. Injuries to the hand are common, especially in road traffic accidents (RTA). The management of these tissue losses is therefore crucial to restore not only the physical integrity of the hand but also the patient's quality of life. Cutaneous substance loss of the hand, though variable in causes and location, remains a major challenge in reconstructive surgery. This work aims to describe the indications, advantages, disadvantages, and complications of the different methods of reconstruction of cutaneous substance loss of the hand and fingers, with a particular focus on local and locoregional flaps. This is a retrospective and descriptive study of 53 patients operated on for hand and finger substance loss in the Department of Plastic, Burn, and Hand Surgery of Avicenne Hospital, Rabat. Favorable outcomes were achieved in 80% of cases, both functionally (mobility and joint flexibility) and aesthetically (preservation of finger length and nail apparatus). Twenty percent of patients experienced complications such as flap suffering, necrosis, infection, stiffness, or sensory disturbance. To avoid amputation stump regularization, various reconstructive techniques have been proposed, ranging from secondary intention healing to microsurgical toe transfers using various types of flaps.

Keywords: Hand reconstruction, Substance loss, Local flaps, Reconstructive surgery, Functional outcomes.

I. INTRODUCTION

The hand is an essential organ of daily life, ensuring a wide range of tasks: domestic, professional, protective, defensive, and communicative. These multiple functions are due to its rich innervation, particularly the digital pulp, which plays a key role in tactile perception (pressure, touch, temperature changes, pain). Its unique shape and adaptability allow for precise contact and optimal adherence to objects. The different pulps of the fingers do not have the same functional importance:

The ulnar pulp of the thumb and the radial pulps of the index and middle fingers are predominant for grasping (pinch), while the ulnar pulp of the fifth digit mainly contributes to environmental perception [1].

The nail plays multiple roles: thermal regulation due to its vascularity, dorsal protection, fine grasping, scratching, defense, aesthetics, and sensory enhancement. Conversely, loss of the nail plate diminishes gripping capacity.

Due to these functions, the hand is vulnerable to trauma with various etiologies such as road traffic accidents, workplace injuries, domestic incidents, and assault (sharp

or ballistic trauma), frequently resulting in soft tissue loss of the hand and fingers.

When reimplantation is not possible, no consensus exists on the optimal therapeutic approach. However, numerous reconstructive methods are available, ranging from simple suturing and secondary healing to skin grafts and various flaps, up to custom-designed microsurgical toe transfers [2-4].

Each of these methods has precise indications depending on the patient's age, medical-surgical history, dominant hand, digit involved, location, size of defect, exposure of noble structures (particularly bone), and presence of fractures.

When properly indicated, each method can yield excellent functional, sensory, and aesthetic results, based on tissue thickness, pliability, grasping, and precision pinch.

The objective of reconstructing substance loss of the hand and fingers is to restore both function and aesthetics, while minimizing donor and recipient site morbidity.

This is a retrospective and descriptive study of 53 patients treated in the Department of Plastic, Burn, and Hand Surgery at Avicenne Hospital, Rabat, combined with a literature review. It emphasizes the utility of reconstruction in cutaneous defects, particularly using local and locoregional flaps, which have yielded better functional and aesthetic outcomes compared to secondary healing and skin grafts.

It also aims to describe the indications, benefits, limitations, and complications of these reconstructive methods with a specific interest in local and locoregional flaps.

II. Patients and Méthods

This is a retrospective descriptive study conducted over a 3-year period from June 2023 to June 2025. Fifty-three patients were referred via surgical emergencies to the Department of Plastic, Burn, and Hand Surgery at CHU Ibn Sina, Rabat.

All presented with post-traumatic soft tissue loss of the hand or fingers and underwent one of the following reconstruction techniques: secondary intention healing, skin grafting, or local, locoregional, or perforator flaps.

The study included 10 women and 43 men (sex ratio 4.3). Age ranged from 18 to 60 years, with a mean age of 30 years. A history of chronic smoking was reported in 59.5% of cases.

Circumstances of injury: work accidents in 72% (rotary saws, electric knives, high-pressure machines), domestic accidents in 15.2% (door-related injuries), and assault in 12.5% (sharp weapons). In 59% of cases, the dominant hand was affected.

Tissue loss involved fingers in 40 patients (thumb: 5 cases; index: 14; middle: 10; ring: 8; little: 3), dorsal hand in 7 cases, and palmar side in 6 cases.

Clinical exam found no flexion or extension deficits. Bone exposure was present in 57%, tendon exposure in 15%, with associated injuries in 7 patients (nail bed wounds or distal phalanx amputations). Radiographs showed distal phalanx fractures in 13 patients.

Flap or graft procedures were performed within 12–72 hours. Most reconstructions were performed in a single stage; some required two. Mean operative time: 90 minutes.

Reconstruction methods were chosen based on several clinical and paraclinical parameters: age, sex, history, dominant hand, involved digit, location and size of defect, Allen and Foster classification, exposure of noble structures (bones, tendons, nerves, vessels), fracture presence, Allen test, and anticipated return to work.

Based on this analysis:

10 patients received secondary healing
5 received full-thickness skin grafts
38 underwent flap coverage: 25 local flaps, 12 locoregional, 1 perforator

Outcome evaluation was conducted at 6 months postoperatively, based on functional, sensory, aesthetic, and occupational recovery.
Aesthetic result: assessed by scar quality and nail appearance.
Subjective sensation: assessed by cold intolerance or contact hyperesthesia. Tactile sensitivity was evaluated using the British Medical Research Council's Nerve Committee scale.
Functionality: assessed by interphalangeal and metacarpophalangeal joint mobility and digit usability.
Occupational impact: assessed by return-to-work time and ability to resume prior tasks.

III. RESULTS

Table 1: Distribution by Reconstruction Method

Reconstruction Method	Number
Secondary healing	10
Skin graft	5
flap	38
Total	53

Flap reconstruction was used in 72% of cases, followed by secondary healing (19%) and skin grafting (9%)

Table 2: Distribution by Flap Type

Flap type	Number
Atasoy	5
Kutler	5
Cross-finger	3
Venkataswami-Subramanian	5
Hueston	2
Moberg	1
O'Brien	1
Thénarien	2
Contrario	3
Colson	4
Interosseux postérieur	1
Cerf-Volant	1
Inter métacarpien	1
Fourcher	1
Mc Gregor	2
Perforator of radial artery	1
Total	38

47% were local flaps, 23% locoregional, and 2% perforator

Table 3: Healing Time by Technique

Healing Time (days)	Healing Time (days)	Skin Graft	Flap	Total
15-20	1	2	22	25
21-30	7	3	9	19
31-45	2	0	7	9
Total	10	5	38	53

47% of patients healed within 15–20 days, 36% within 21–30 days, and 17% within 31–45 days. Postoperative outcomes were uneventful in over 80% of cases. Functional, sensory, and aesthetic results were satisfactory in 80%.

Complications (20%): included 1 case of transient venous congestion, 1 partial necrosis (treated by debridement and secondary healing), 2 infections (managed with tailored antibiotics and dressing changes).

Functional results were excellent in 80% of flap patients, thanks to adequate thickness, vascularity, and tissue quality.

Secondary healing and skin grafts yielded inferior outcomes (50% and 40% respectively), due to insufficient thickness, limited sensation, and scar contractures. Joint stiffness (2 PIP+MCP, 1 wrist) occurred, requiring early physical therapy.

Sensory outcomes (MRC scale):
S3/S3+: 72.3% (27 patients) – mostly flap group
S2: 50% in secondary healing (5 patients), 35% in graft group (2 patients)
No S0/S1 observed
2 cases of contact hyperesthesia and 2 of cold intolerance had no functional impact.

Aesthetic outcomes: satisfactory in 80%; 2 cases of nail dystrophy (due to trauma or skeletal shortening), 1 hypertrophic scar (well tolerated).

All patients resumed previous work with a mean return-to-work time of 20 days. Flap reconstructions accounted for 42% of those who resumed work within this period.

Fig 1: Atasoy flap of tissue defect pulp finger D2

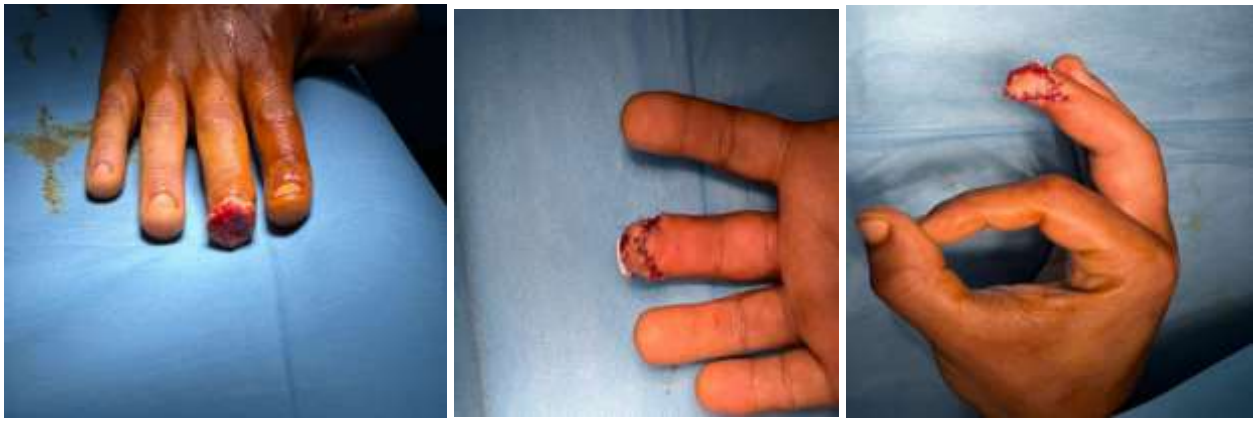

Fig 2: Kutler flap of soft tissue defect pulp finger D3

Fig 3: Venkataswami-Subramanian flap of soft tissue defect pulp finger D2

Fig 4: Islet neurovasculary of homodigital Contrario flap of soft tissue defect finger D2

Fig 5: Posterior interosseous flap of soft tissue defect side face of right hand

Fig 6: Fourcher flap of soft tissue defect in palm finger D1

Fig 7: Lambeau de Mac Gregor flap of soft tissue defect in 1er corner of right hand

Fig 8: Colson flap of soft tissue defect of ring finger de D4 in right hand

Fig 9: Hueston flap of soft tissue defect pulp finger D1 of right hand

IV. DISCUSSION

Numerous techniques have been described for the reconstruction of pulp defects, and many remain widely used today, ranging from secondary healing and skin grafting to local or locoregional flaps.

In some cases, microsurgical pulp transfer from the toe can be considered. However, the donor site aesthetic sequelae are not negligible, and there is a risk of joint stiffness due to prolonged immobilization (typically 3 weeks) [5].

The options for coverage of soft tissue defects in the hand are varied and must be selected based on the specific characteristics of each injury. The choice of coverage method should be carefully considered, taking into account factors such as defect location and size, the patient's general condition, Allen's classification, healing time, and functional objectives. The main goal is to restore a sensitive, functional hand with good trophic quality, while minimizing sequelae at the donor site and ensuring timely return to work.

Secondary intention healing remains a valuable option for some lesions that do not require complex reconstructions. However, its limitations include prolonged healing time, infection risk, unaesthetic hypertrophic scarring, insufficient tissue thickness, and delayed return to activity. **Skin grafting**, like secondary healing, generally yields poorer outcomes compared to local flaps.

Full-thickness skin grafts can be used to cover digital or hand defects. Mechanically, they are stable and non-contractile, providing a good-quality covering. However, they lack the pulp-like characteristics in terms of pliability and thickness. Sensory recovery is better than with split-thickness grafts, but still inferior to innervated flaps.

In summary, the role of skin grafts in pulp reconstruction is limited due to their mechanical and sensory shortcomings and the need for strict postoperative monitoring (graft take at Day 5, healing in 3–4 weeks, risk of retraction until Day 20). Complications include neuroma, hematoma, infection, dyschromia, or graft failure.

Today, only two exceptional indications for skin grafts remain:

- As a temporary "dressing-graft" pending complex microsurgical reconstruction;
- Palmar bevel amputations in zone 1, when occupational constraints require rapid healing.

The experience accumulated in this study highlights the effectiveness of **flaps**, which provide adequate vascularity, allow coverage of significant substance loss, and help preserve motor and sensory function. The few complications observed emphasize the importance of close postoperative monitoring.

CONCLUSION

Reconstruction of soft tissue loss in the hand and fingers is complex, requiring careful consideration of multiple parameters to determine the most appropriate technique. Our study demonstrates highly satisfactory outcomes functional, sensory, and aesthetic with a rapid return to previous activities when flap techniques are used. These flaps offer robust, well-vascularized, and pliable tissue with minimal donor site morbidity, thereby establishing their superiority over secondary healing and skin grafting in managing hand and finger tissue loss.

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