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RESEARCH ARTICLE

LOCAL SKIN FLAPS IN RECONSTRUCTION OF DIGITAL TISSUE LOSS, A CONCISE VARIETY

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ABSTRACT

Local skin flaps are the best covers for digital soft tissue loss, meeting the goals of reconstruction, in providing adequate stable cover with similar skin quality, preserving adequate tactile gnosis sensibility, functional lengths, and acceptable cosmetic appearance. out of total 94 operated cases, at Aljala teaching trauma hospital and Ebn- Sina private hospital, between (2011 and 2016), are selected to report both objectively and subjectively the functional and cosmetic outcome, using local flap techniques in reconstruction of significant digital soft tissue loss, after an average follow up period of 1 year.

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INTRODUCTION

The hands are complex parts of our body, known to all of us as a satisfaction, defensive, communicative and creative tools, (Hegge *et al.,* 2011) Therefore designed that every inch of which is worthy to gain its place, including its skin envelope that is also an exceptionally prepared structure. Consequently, unless their damages are handled correctly, temporary or permanent disability will be the result. Several reconstructive methods have been proposed for the treatment of fingers and thumb injuries, including the allowance of healing by secondary intension, (Cohen and Cronin, 1983) the primary wound closure, split and full thickness skin grafting, (Uysal *et al.,* 2006) the local and distant pedicle and axial flaps, (Deglise and Botta, 1991; Koshima *et al.,* 2010; Atasoy *et al.,* 1970; Furlow *et al.,* 1984; Hueston, 1966) and the free vascularised tissue transfer (Cohen and Cronin, 1983; Dellon, 1983; McGregor, 1979; Friedrich *et al.,* 2009). Such huge diversity made it more difficult because neither injuries nor patients are the same. Therefore, patient's personal data, medical and surgical history, the injury mechanism, elapsed time since injury and the previously given first aids or management are essential for evaluation of the likely structural involvement. Along with the defect anatomical location, shape, size, depth, and composition, as well as the functional losses, should be determined to decide the best reconstructive intervention based on the patient and injury individualities (Xu *et al.,* 2007; Lister, 1993). In general, dealing with these injuries the goals should be; The adequate, painless, stable and sensible defect cover, by similar skin quality and color**;** Preservation of good functional length, and useful joints mobility; With minimal donor site morbidity; and The early patient's return to work and previous activities (Trumble, 2010; Beasley, 1969). Although these goals converge with the idea of local flaps application, including: The Z-Plasty, V-Y Advancement Flap (Atasoy Flap), (Atasoy *et al.,* 1970) Bilateral Triangular Advancement Flap (Kutler Flap), (Kutler *et al.,* 1947) Oblique Triangular Flap, (Venkataswami and Subramanian, 1980) Homodigital Bipedicle Island Advancement Flap (O'Brien), (O'Brien, 1968) Moberg Volar Advancement Flap, (Moberg, 1964) Thenar Flap, Cross-Finger Flap (Transdigital Flap), Inter-Metacarpal Axial Skin Flaps, Reverse Dorsal Digital and Inter-Commissural Flaps, (Valenti *et al.,* 1990) Neurovascular Island Flap, Holevich Racquet Flap, Foucher Kite, Brunelli Flap, and Annular Flaps. Their major limitation in the hand is the less availability of donor skin. This concise variety of local skin flaps built-in here, that we used for reconstruction of some common significant digital and thumb defects may help, however, no one can claimed standard models, Therefore each defect should be dealt with as a unique entity.

METHODS

Selected are 59 injured fingers and thumbs out of totally operated 94 emergency and elective cases, referred to the hand surgery unit at Al-Jala teaching trauma hospital, and Ebn-Sena

private hospital, between (2011 and 2016), With significant skin and soft tissue defects, caused by a mixture of traumatic mechanisms. To report the useful application of some local pedicle and axial flap techniques, in the emergency and elective reconstruction of some common digital defects, after an average follow up period of 1 year. Using objectively; The static 2 point discrimination test, ranking (less than 6 mm. normal, and more than 11 mm. poor); The active range of movement (ARM), at distal interphalangeal (DIP), proximal interphalangeal (PIP), and metacarpophalangeal joints, and the subjective questioning of patients about; Their satisfaction of hand appearance; Presence of pain, evaluated by the visual analog scale (VAS), considering Zero as pain free, while 10 as pain at rest; and Their ability of return to previous work and activities. Excluded are; those missed for follow up; cases managed by distal pedicle flaps; and the severely crushed digits beyond repair.

RESULTS AND DISCUSSION

Fingers and thumb soft tissue loss are common injuries, (Alwis, 2006) account for approximately 10% of all accidents, (Sanjay Saraf and Tiwari, 2007; Karthi Sundar *et al.,* 2017) that can be associated with deeper vital structural (bone, tendon, and/or digital neurovascular bundles) damages, adding complexity to their management. For that, many several ideas have been introduced including the allowance of healing by secondary intention, direct closure, skin grafting, and the more complicated microsurgical free vascularised tissue transfers, Passing through the less demanding local and distant pedicle flap, designs. The choices in between depend on; the defect size, and tissue availability; its anatomical location, and associated injuries; available facilities; the patient's age; and functional demands (Xu *et al.,* 2007). Among this diversity, we are presenting the usefulness of some different local flaps used in reconstruction of 59 injured finger and thumb, out of total 94 cases operated by the hand surgery unit, for treatment of significant skin loss varying between (0.5×1 cm and 2 ×3.5 cm), at Aljala teaching trauma hospital and Ebn-Sena hospital, Between the years 2011 and 2016. Out of the total 94 cases, 8 missed for follow up, 3 treated by skin grafting, 9 distant pedicle flaps, and 15 severely mutilated digits beyond repair went for amputation, were excluded. The 59 selected cases, (41 males, 18 females), between 3-62 years of age, (mean=26 years).

The involvement was Nine thumbs, 23 index, 16 middle, 8 ring, and 3 little fingers. (Paragraph 1), showing the highest frequency in the index, followed by the long finger, least involving the little.

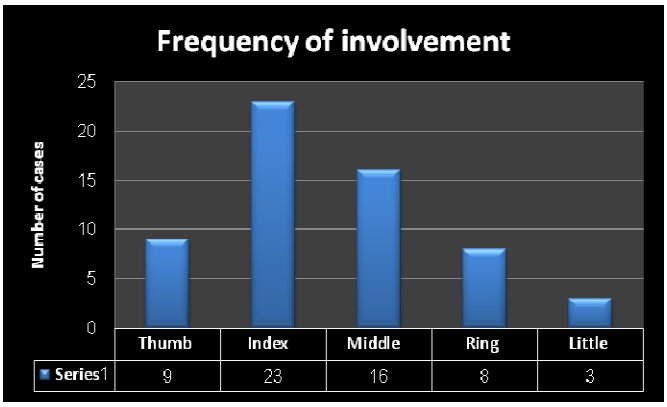


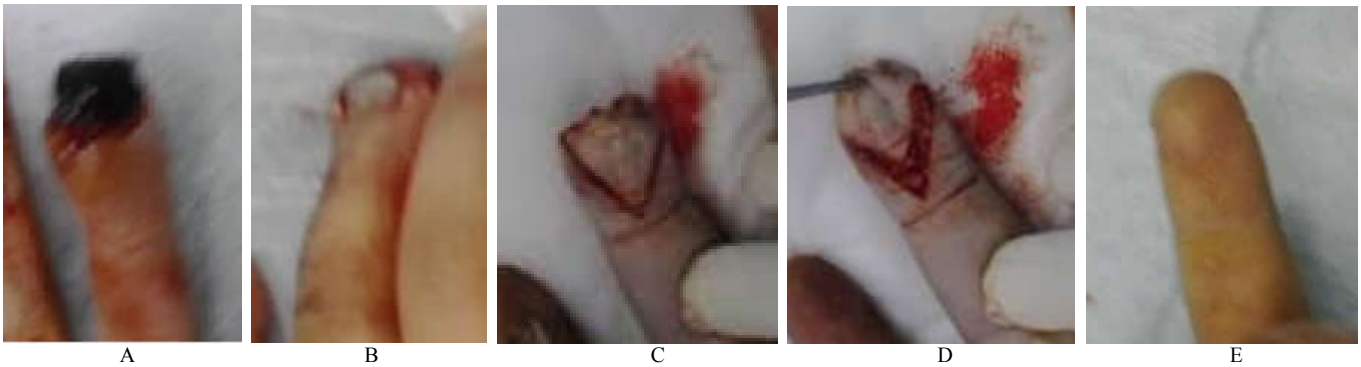
Figure 1. The most frequently involved are the index, followed by the middle fingers, and least involving the little

Table 1. Types of local pedicle flap used, and the number of cases applied to soft tissue loss plan

Flaps	Number of cases	Tissue loss plan
Thenar flap	23	15 volar oblique + 8 transverse
Cross finger flap	17	11 volar + 6 dorsal
Advancement flap	11	7 Volar oblique + 4 transverse
Intermetacarpal flap	6	1 volar + 5 dorsal
Cocked Hat flap	2	thumb disarticulation at MP joint level

The most frequent causative mechanisms among physiologically young active patients were machinery accident, 28 cases; followed by crushing of heavy objects 9; and the bite injuries 5 cases (3 Human and 2 animal bites). While door injuries were the most common in children 17 cases**.** Majority of these defects are involving solitarily the distal phalanges (DP) 49, both DP and middle phalanges (MP) 6 cases, and were least in relation to the proximal phalanges (PP) 4 defects. Associated fractures detected in 17 cases, 14 involving the DP Taft area, 2 MP, and 1 PP shaft areas. Nail plate avulsion and nail bed injuries 19 cases, Injured extensor tendon expansion 2, and digital neuro-vascular bundles 3 cases. As shown in (Table -1), The thenar flaps employed in 23 cases, Cross finger flaps 17, Advancement flaps 11 (4 Bipedicle, and 7 V-Y), Intermetacarpal flaps 6 cases (4 distally based, and 2 proximally based), Cocked Hat flap 2 cases.

Case -1



13 y old male patient, presented as a case of Rt. index fingertip injury, by a bicycle chain, referred the fifth day post-trauma with transverse loss of fingertip soft tissue and exposed Taft area (A, B).
Following debridement, the case treated by (Atasoy V-Y) advancement flap (C, D).
Eight months post surgery, the patient was satisfied with the result, with normal shape and color, sensible skin, a full range of movements and two-point discrimination of 4 mm (E).

Case 2


A


B


C


D

34 years old male patient, injured by an electric powered saw, presented by volar oblique tip injury of Lt. index, with amputated Taft area of the DP. The defect was 1.5 x 2 cm (A).
Treated by Homodigital bipedicle advancement flap (O'Brien flap), the proximally resulted raw area at the distal interphalangeal crease covered by a full thickness skin graft, harvested from the wrist region volarly (B, C).
The flap and graft survived, and the sight of graft closed primarily by interrupted sutures (D).
6 months postoperatively, the patient was satisfied with the result, skin color and texture were normal, with a full range of flexion-extension movements, and 2 point discrimination of 4 mm.

Case 3


A


B


C


D


F


G


H

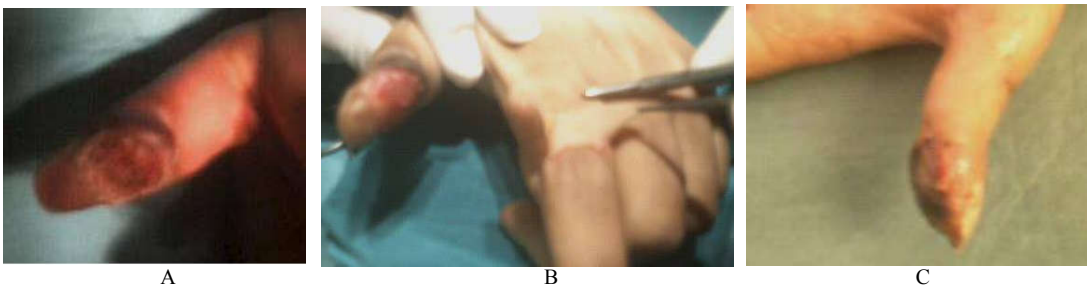
21 years old male patient. A case of machinery accident, presented by Rt. middle fingertip amputation, and a defect of (1.5 x2 cm.), associated nail bed laceration and avulsed nail plate (A).
Managed by thenar flap, nail bed repaired by 6/0 vicryl interrupted sutures, the nail folds kept open by a harvested vaseline gauze piece (B), The donor area covered by full thickness graft, from the volar wrist region.
The flap separated at second week time (C, D, F).
Two years post surgery, the patient was satisfied with the finger shape and color, a new nail grows up with minimal hooking, good function, and sensibility, and two-point discrimination of 5 mm (G, H).

Case -4

A B C D

27 years old male patient, presented following machinery accident, involving his Rt. Index finger, with a defect of (1 x 2 cm.), and a tangential volar-ulnar pulp amputation, with an associated volar tangential loss of the DP Taft and shaft areas, just distal to the base (A).
managed by cross finger flap designed from dorsal metacarpal skin of the long finger, the raw area covered by full thickness graft from wrist region (B,C).
6 months postoperatively, he was satisfied with the result, with normal finger shape and color, a normal range of movements, and two-point discrimination of 8 mm (D).

Case -5



A B C

A cross finger flap technique found to be useful in the reconstruction of an accessible volar thumb defect, in 28 years old male patient, with pulp skin defect of Lt. thumb, measuring (1.5 x 1.5 cm), due to mechanical crush (A).
The flap harvested from the index PP. dorsal skin (B), Separated at second week time (c).
Six months post surgery he was satisfied with the result, with normal pulp shape, a normal range of movement, and two-point discrimination of 10 mm.

Case -6

A B C

D E F

19 years male patient, with relatively extensive irregular soft tissue loss at the volar-radial aspect of his Rt. thumb DP extending proximally through the interphalangeal joint up to the neck of the PP level. Following machinery crush injury, with missed articular volar 1/3 of the DP (A).
Following meticulous debridement, the interphalangeal joint arthrodesed, a skin flap harvested at the level of the proximal phalanx, based on the first dorsal metacarpal artery, is tunneled under the 1st web skin bridge, to be fixed covering the thumb defect, The resulting donor raw area covered by full-thickness skin graft from the wrist region (B,C, D).
One year post-surgery, the patient was satisfied with the shape, color, and function of his thumb, with two-point discrimination of 11 mm (F).

Case -7

A B C

31 years old Egyptian M P. Presented with soft tissue defect of (2 x 2.5 cm.), at the dorsal-radial aspect of Lt. index, associated with an injured third digital neurovascular bundle and partial cut of the extensor expansion, caused by vehicle's motor radiator fan (A).
Managed by a reversed axial fascio-cutaneous flap, Harvested from the second metacarpal space skin area, Based on the second dorsal metacarpal artery from the dorsal carpal arch. The flap is then rotated and tunneled under skin bridge to cover the defect distally, and the donor area closed primarily (B, C).
Eight months post-surgery the patient was satisfied with the result, improving ranges of motion, However anesthesia at the radial half of the index still there, and the 2 point discrimination was 12 mm.

Case -8

A B C D

A horse bite injury in 29 years old male patient, resulted in a complete amputation of Lt. thumb through the base of the PP. presented 4 months post metacarpophalangeal joint disarticulation (A).
Treated by one stage osteoplastic thumb reconstruction, using a bone grafting harvested from the iliac crest, covered by cocked hat pedicle flap technique (B).
8 months later the result was a functional lengthening, with a sensible stump, and 2 point discrimination 6 mm (C, D).

Compared with other mentioned techniques, the local pedicle flaps gained a wide range of acceptance, and extensive applications, in covering relatively large digital defects, preserving functional lengths, at least protective sensibility, with similar skin quality in color and texture, less time consuming and technical demands. However these aims cannot be achieved unless appropriately designed and meticulously performed to cover the defects with no tension or excess bulk, and the avoidance of pedicle twist or kinking, as their survival is related to the balanced in and outflow, that is early established by the blood supply through their pedicles, and later by the development of micro-vascular connections between the flaps and their surrounding normal skin edges and recipient beds. The establishment of such microcirculation and therefore the flap survival is disproportionally related to the flap size but proportionally related to its thickness and pedicle width. In our series, all the flaps survived with good functional and esthetic results, with no obvious shortening, or nail hooking, and normal or near normal pulp appearance, fair sensibility, with an average static 2 point discrimination of 8 mm, and ranged active interphalangeal and metacarpophalangeal joints flexion-extension movements of 90-110° in 53 cases. Restricted range of active movement, 45-80° measured in 5 cases, including the 2 cases treated for an associated extensor tendon cut, repaired as an emergency at the time of the defect reconstruction. The (ARM) was 0°, in one arthrodesed thumb interphalangeal joint, reconstructed by an intermetacarpal flap. All patients were satisfied with their hand appearance, the visual analog score (VAS) was Zero, and all returned back to normal activities, within 6 months.

Conclusion

1. In treating fingers and thumb tissue loss, the local flap techniques, provide satisfactory functional and esthetic covers by similar skin quality, less time consuming, less technical demands, and less complications both at the recipient and donor sites.
2. The flap choice is case individuality, and surgeon preference dependent.

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