

# Results of the application of neurovascular homodigital flaps on cutaneous defects of digital fingertips

## Abstract

**Introduction:** traumatic injuries of the hand are in the top list of working Industrial accidents. The treatment of these injuries has as goal to restore the function of fingertips, improving the patients' quality of life.

**Objective:** Evaluate results of the application of neurovascular homodigital flaps on cutaneous defects of digital fingertips of the hand large fingers.

**Method:** an observational and descriptive investigation was conducted in a case chain of 33 Patients at Hermanos Ameijeiras Hospital from October 2013 to January 2015. Were Neurovascular homodigital flaps applied with direct circulation (17 patients) or indirect circulation (16 patients).

**Results:** male sex was more affected; frequency was higher Between 36 and 41 years old and over 41 years old. Four complications were confirmed representing 12%. 72.7% obtained good and excellent results with the application of these surgical techniques receiving an appropriate protector of sensibility and satisfactory cutaneous covering. Application of these procedures was 93.9% satisfied.

**Conclusion:** The application of neurovascular flaps homodigital was established on cutaneous defects of digital fingertip of the hand large fingers.

**Keywords:** complex lost of substance, trauma of the large fingers, amputation, fingertip injury, neurovascular flaps

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## Introduction

The frequency of hand injuries in industrialized countries accounts for a third of all accidents. Often hand wounds are treated by inexperienced surgeons, who explain much of the aftermath after the accident.<sup>1</sup> There are multiple surgical procedures to treat the losses of complex substance of the digital pulp: directed scarring, the skin free graft, the Kutler and Atasoy flaps and the homodigital neovascularized flaps. The homodigital neovascularized flaps on the island are used in the center in question because the transferred tissue satisfies the requirements of the reconstruction of the spine both mechanically and sensitively, providing a satisfactory protective sensitivity to the recipient area without affecting the main finger sensitivity Donor, which motivated us to evaluate the results of its application taking into account the age, sex, type of amputation, mechanism of production, occupation and the time of evolution and incorporation to work. The main complications of the surgical treatment were also determined. The objective of this research is to expose the results of our experience since the procedures we apply, in addition to providing adequate skin coverage, provide a satisfactory protective sensitivity to the recipient digital pulp.

## Methods

The study universe was constituted by patients with complex loss of substance from the digital pulp of the long fingers of the hand, coming from the consultations of the "Hermanos Ameijeiras" Clinical Surgical Hospital. The sample consisted of 33 patients with complex substance loss of the long fingers of the hand with a surgical criterion of homodigital neovascularized and operated iliac flaps on the island.

Direct circulation flaps were applied to 17 patients or indirectly to 16 patients.

## Inclusion criteria

- I. Patients older than 18 years of age.
- II. Patients with digital pulp lesion with complex substance loss of the long fingers (2nd to 5th fingers), zones 2 and 3 of Merle and Dautel.
- III. Postoperative follow-up of 6 months.
- IV. Acceptance of surgical treatment by the patient.

## Exclusion criteria

- I. Patients with thumb lesions.
- II. Patients who refuse surgical treatment.
- III. Patients who do not attend scheduled appointments.
- IV. Patients who voluntarily wish to leave the study.

## Interruption or exit criteria

- I. Patients leaving the outpatient follow-up.
- II. Patients who do not comply with the medical indications.

## Variables

The variables age, sex, production mechanism, occupation, type of amputation (cut obliquity), interval between injury and surgery, surgical technique, incorporation and complications were used. The evaluation of the results was performed according to scale of Excellent, Good, Regular and Poor considering: necrosis of the flap, protective sensitivity, static two-point discrepancy (S2 PD), dynamic two-point

discrepancy (M2 PD), hypertrophic scar at edges of the donor site pain, retractile scar surgical wound, total active flexure (*total active motion*) interphalangeal (TAM), contracture flexion or extension of the metacarpophalangeal joints and proximal interphalangeal, stiffness and patient satisfaction.

## Procedures

Patient in supine position in operative table, arm is placed on hand table, asepsis and antisepsis of the hand is performed, field cloths are applied, regional or local anesthesia is applied (2% lidocaine diluted to 1%) and placed Pneumatic tourniquet for ischemia.

### Homodigital flap on Neovascularized Island of direct circulation

The island is drawn at the distal end of the affected finger to be used to cover the cutaneous defect. A mediolateral incision is made on the radial side if the affected person is the 2nd. or the 3rd. Finger, and on the ulnar side if it is the 4th or the 5th. The island flap is released from the flexor sheath. When sectioning the medial side of the flap is advisable to carry out a careful hemostasis of the arterial vascular arch of the pulp. The perivascular fatty environment of the pedicle must be preserved. The dissection of the pedicle can be carried proximally until it reaches the level of the commissure. It is necessary to locate and electrocoagulate the two Edwards anastomotic arches, in the proximity of the distal metaphysis of the first and second phalanges. The progress obtained is a product of the dissection of the pedicle and of the placement in flexion of the interphalangeal joints. The flap is placed at the receptor site and fixed with a percutaneous needle, which will be removed by suturing the flap with single stitches as well as the rest of the surgical wound (Figure 1). The donor site is grafted using a skin of intermediate thickness, taken from the hypothenar eminence.<sup>1-3</sup>



**Figure 1** neurovascular motion homodigital flap. A) Preoperative. B) Transoperative. C) Postoperative.

### Homodigital flap on neurovascularized Island with indirect circulation

The island is drawn at the proximal end of the affected finger (palmar face of the first phalanx) to be used to cover the cutaneous

defect, a mediolateral incision is made on the radial side if the affected finger is the 2nd. OR the 3rd. Finger, and on the ulnar side if it is the 4th. or the 5th. After determining the size of the flap, the collateral nerve corresponding to that area is sectioned at the level of the palm of the hand, leaving a stump of the nerve surrounded by palmar adipose tissue. The palmar collateral artery is in turn sectioned between two ligatures of the proximal border of the flap on the island. The dissection proceeds from proximal to distal, individualizing the pedicle, away from the pedicular elements. The dissection stops before reaching the neck of the second phalange so as not to damage the anastomotic arch that will feed the flap with inverted circulation. Rotation of the flap is performed to cover the skin defect. Microsurgical suturing is performed between the distal end of the healthy contralateral digital nerve and the nerve of the flap. The flap is sutured with simple dots at the level of the loss of substance of the pulp, the cutaneous defect of the donor site is covered using total skin graft (Figure 2).<sup>1-3</sup> Statistical analysis used summary measures for qualitative variables such as percentages, and for quantitative means and standard deviation. To compare the means of age according to the outcome of the surgery, the Kruskal-Wallis nonparametric test was used, due to the small sample sizes, with a significance level of 0.05.

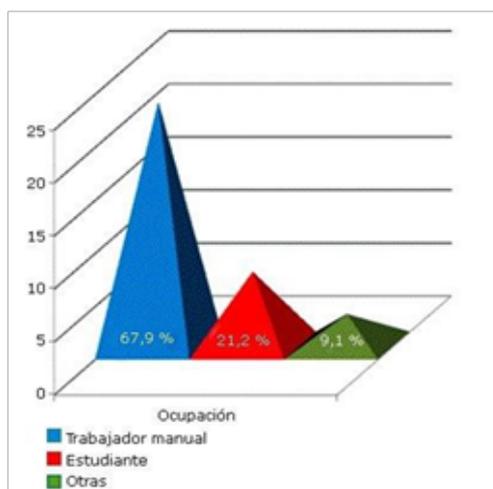


**Figure 2** Homodigital flap of indirect circulation. A) Preoperative. B) Transoperative. C) Postoperative.

## Results

The most affected age group was individuals between 36-41 years old, with 10 patients (30.3%), followed by the > 41 years, 9 patients (27.3%). The mean age was 37.3±10.3 years. According to the mechanism of the project it showed that the most common mechanism crushing was represented by 23 patients (69.7%) (Table 1). As for the occupation of patients, those most affected were manual workers, 23 patients (69.7%) (Figure 3). In the series he studied predominated transverse injury of the pad, represented by 21 patients (63.6%) (Table 2). Regarding the time from injury and surgery time they predominated operated patients after 72 hours, 27 patients (81.8%) (Table 3). Regarding the return to work or normal activities in the series (Table 4), predominant group of patients enrolled to normal activities between 4-6 weeks, 23 patients (69.7%). Regarding the final results of the research, 24 patients (72.7%) obtained excellent and good results. The 2 patients (6.1%) with poor results had: 1) total

flap necrosis (a diabetic patient over 30 years of age, hypertensive and smoker with more than one box of cigarettes per day), 2) stiffness flexion of the proximal interphalangeal joint by lack of physiotherapy and uncooperative patient (Table 5). There were 4 complications (12%). The first was total necrosis of the flap in a 55-year-old patient, diabetic over 30 years of age, hypertensive and smoker of more than one cigar box per day. In order to solve this problem, necrectomy and directed scarring were performed, but the patient lost the possibility of more adequate skin coverage and a satisfactory protective sensitivity, and was therefore dissatisfied, as described previously. The second complication was flexural stiffness of the proximal interphalangeal joint due to lack of physiotherapy and poor patient cooperation, which was resolved with a second surgical procedure in which the retinacular ligaments were sectioned on both sides of the proximal interphalangeal joint. The lateral recesses of the plate fly. The third complication was partial necrosis of the flap in another patient of 57 years, diabetic 13 years of evolution and alcoholic. Surgical debridement and directed scarring were also performed, but with necrosis being partial, the rest of the flap showed adequate coverage with satisfactory protective sensitivity, without affecting patient compliance. The fourth complication was a parrot beak deformity in a male patient 30 years, baker that despite the deformity was satisfied because his main objective was to solve the cutaneous defect with a satisfactory protective sensation (Table 6).



**Figure 3** Distribution of patients according to occupation.

**Table 1** distribution of patients according to production mechanism

Mechanism production	No.	%
Flattening	23	69,7
Incised wounds	9	27,3
Bites	1	3,0
Total	33	100

**Table 2** Distribution of patients according to type of amputation

Type of amputation	No.	%
Radial oblique	2	6,1
Oblique oblique	3	9,1
Palmar oblique	7	21,2
Transverse 2	21	53,6
Total	33	

**Table 3** Distribution of patients according to injury-operation interval

Injury-operation interval (hours)	No	%
< 24	2	6,1
24-72	4	12,1
>72	27	81,8
Total	33	100

**Table 4** distribution of patients according to incorporation to work

Incorporation to work (weeks)	No	%
<4	-	-
4-6	23	69,7
7-8	7	21,2
>8	3	9,1
Total	33	100

**Table 5** Distribution of patients according to results

Results	No	%
Excellent	8	24,2
Good	16	48,5
Regular	7	21,2
Bad	2	6,1
Total	33	100

**Table 6** Distribution of patients according to complications

Complications	No. (n=33)	%
Total necrosis of the flap	1	3,0
Joint stiffness (MF, IF P, IF D)	1	3,0
Partial necrosis of the flap	1	3,0
Other	1	3,0
Total	4	12,0

## Discussion

According to the literature consulted, age groups between 36-41 and 41 years are more likely to present such lesions, because at these stages people are more labor-intensive.<sup>1-3</sup> in the fourth decade of life there is a work experience that provides greater confidence when handling tools, which causes failure of protective measures. They also decrease the individual's physical abilities (visual deficit, coordination of fine manual movements, decreased ability to react to dangers). *Campbell*<sup>4</sup> mentions the number of Adani and others showing a higher frequency of injury of military fingertip in males, which is based on a higher performing manual riskier activities by men compared to women. Due to the great industrial development and the incorporation of multiple complex heavy machinery, crush trauma and avulsive contusional wound are more frequent than incisional wounds and bites. Some authors<sup>5-9</sup> matches our report. With the increase of industry and the mechanization of work tools, the manual worker, by the nature of his trade, traumatizes his hands. The hands top the list of industrial accidents and are responsible for much of the costs of compensation. French annual report Statistics<sup>10-12</sup> 360 000 hand accidents (32% of accidents).<sup>13-15</sup>

Frequently the mechanisms of production that cause these injuries

contribute great contamination of the wounds that, moreover, were established around the 72 hours. Montealegre<sup>16</sup> menciona un estudio porgodina performed in which an incidence of infection of 1.5% using a protocol excision of the lesion and skin coverage by microsurgery in 72 hours and an incidence of infection of 17.5% with the closing of the recorded Wound within 72 hours. Dautel<sup>17</sup> quotes and Schoker Lister, who presented their results satisfactory studies, performed using skin coverage by using flaps within 24 hours of injury. In other studies reviewed, no significant differences in infection rates were observed when comparing the primary emergency transfer of free and/or vascularized tissue versus the deferred primary or secondary.<sup>18</sup> Deferred treatments allow evaluating the injury for the second time, proving the viability of the member to plan more accurately intervention. However, no infection was found in our series before or after 72 hours.<sup>18,19</sup> In literature it is eluded to demonstrate that the incorporation estudiosque work fluctuated between 5-6 weeks after surgery,<sup>20-22</sup> while in our series, cases built after eight weeks were those with complications. Incorporation before four weeks is difficult when more complex surgical techniques are applied since healing and rehabilitation require at least one month of evolution to obtain a satisfactory result. The different studies reviewed coincide with our investigation, demonstrating excellent results with the use of homodigital neovascularized flaps in the coverage of complex substance losses of the pulp.<sup>4-17</sup> According Merle<sup>3</sup> the most frequent complications include total and partial flap necrosis and metacarpophalangeal joints stiffness, proximal interphalangeal and/or distal coinciding with reports by various authors. The study showed similar results to those obtained in the literature. The efficacy of the application of the neovascularized homodigital flaps on the complex loss of the substance of the pulp in the long fingers of the hand was demonstrated, obtaining adequate skin coverage and a good protective sensitivity satisfactory to the digital pulp.

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None.

## Conflicts of interests

The author declares no conflict of interest in the study.

## References

1. Albaladejo F. *Cutaneous skin cover of the fingertips*. 3rd edition. Madrid: Editorial Jarpyo Editores; 2003. p. 36–54.
2. Coiffman F. *Plastic, reconstructive and aesthetic surgery, surgery of the hand and upper limb*. Colombia: Editorial Amolca; 2008. p. 111–52.
3. Merle M, Dautel G, Loda G. *Traumatic hand, Emergency*. Madrid: Editorial Jarpyo Editores; 2005. p. 201–22.
4. S Terry Canale. *Campbell Campbell's Operative Orthopedics*. Eleventh Edition. Philadelphia, Pennsylvania: Editorial; 2013. p. 155–78.
5. Llorente Pendás JL. *Free flaps in head and neck reconstructions*. Madrid: Editorial Garsi, SA; 1997. p. 121–133.
6. Masquelet AC, Gilbert A. *The flaps of coverage in the lower extremity*. London, United Kingdom: Editorial Springer-VerlagIbérica; 1992. p. 303–306.
7. Loda G. *Atlas of thumb and finger reconstruction*. 3<sup>rd</sup> edition. New York: Editorial Thieme Stuttgart; 1999. p. 402–413.
8. Dunitz M. *Reconstructive surgery in hand mutilation*. 2<sup>nd</sup> edition. Barcelona: Publisher: Printed and bound in Spain by Grafos SA Art on paper. 1997. p. 201–205.
9. Boscheinen MJ, Bruce CW. *The hand: Fundamentals of therapy*. Third edition. London, United Kingdom: Editorial Butterworth Heinemann; 2001. p. 156–160.
10. Chung K. *Reconstruction of the hand and upper extremity*. 1<sup>st</sup> edition. Colombia: Editorial Amolca; 2011. p. 162–173.
11. Masquelet CA, Gilbert A. *An Atlas of flaps of the musculoskeletal system*. 1st. Ed. London, United Kingdom: Editorial Taylor & Francis Group; 2001. p. 132–140.
12. Masquelet AC, Gilbert A. *An Atlas of Flaps in Limb Reconstruction*. 2<sup>nd</sup> edition. London, United Kingdom: Editorial Taylor & Francis Group; 2001. p. 158–160.
13. Balletero R. *Loss of substance; A challenge in Traumatology and Orthopedic Surgery*. 1st. edition. Madrid: Editorial Mapfre Medicina; 2012. p. 107–122.
14. Edmonson A, Crenshaw A. *Microsurgery, Orthopedic surgery*. Madrid, Spain: Panamerican Medical Publishing House; 2000. p. 126–43.
15. López Beltrán R, Hernández Gutiérrez R, Navarro González A, Hernández Suárez B. Wide dorsal flap: An essential technique in reconstructive surgery of the upper limb. *Rev Cubana OrtopTraumatol*. 2006;20(1).
16. Montealegre G. *The traumatized hand, fingertip injuries, skin cover and infections and primary care in the trauma of the hand*. Guides of Clinics of Plastic Surgery of the Hospital of San José. Bogotá: University Foundation of Health Sciences; 2007. p. 102–106.
17. Dautel G. *Cutaneous cover. Free flaps. Traumatic hand*. 2<sup>nd</sup> edition. Barcelona: Masson; 1995. p. 114–139.
18. Peter J, Jabson L, Louis D. *Amputations*. In: Scott W. Wolfe. *Green Operative Hand Surgery*. United States: Elsevier; 2011. p. 1885–928.
19. Lesavoy Malcolm A. *Flaps and approaches*. In: McCarthy Joseph, et al., editor. *Plastic surgery*. Hand. Vol. 1. Madrid, Spain: Editorial Médica Panamericana SA; 1992. p. 208–26.
20. Browne EZ. *General principles in the treatment of skin lesions*. In: Mc Carthy Joseph, et al., editor. *Plastic surgery*. Hand. T. 1 Madrid, Spain: Panamerican Medical Publishing House; 1992. p. 197–207.
21. Lakshmanan P. *Amputation, Fingertip*. Medscape. 2013.
22. Tailor R. *Wounds of the hand. Guidelines for emergency management*. Bogotá: Ministry of Social Protection; 2003.