

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

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## Abstract

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

**Objective:** to evaluate results of the application of neurovascular homodigital flaps on the cutaneous defects of the digital fingertip of the large fingers of the hand.

**Method:** it was perform an observational and descriptive type investigation, in a case chain of 33 patients on the Hermanos Ameijeiras Hospital in the period of October 2013 up to January 2015, were it was apply neurovascular homodigital flaps with direct circulation (17 patients) or indirect circulation (16 patients).

**Results:** male sex was more affected, with a higher frequency between 36 and 41 years old and also over 41 years old. There was confirmed 4 complications representing the 12%. It was obtained a 72.7% of good and excellent results with the application of these surgical techniques getting an appropriate protector sensibility and a satisfactory cutaneous covering. The patients were satisfied in a 93.9% of the cases with the application of these procedures.

**Conclusions:** it was demonstrated the efficiency of the application of neurovascular homodigital flaps on the cutaneous defects of the digital fingertip of the large fingers of the hand.

**Key words:** complex loss of substance; trauma of the large fingers; amputation; fingertip injury; neurovascular flaps

## Introduction

The frequency of hand injuries in industrialized countries represents a third of all accidents. Hand injuries are often treated by inexperienced surgeons, which explains a large part of the aftermath after the accident.

There are multiple surgical procedures to treat losses of complex substance from the digital pulp: targeted healing, free skin graft, Kutler and Atasoy flaps, and neurovascularized homodigital flaps. In the center in question, the homo-digitized neurovascularized island flaps are used because the transferred tissue satisfies the requirements of the reconstruction of the pulp, both from the mechanical and the sensitive point of view, providing a satisfactory protective sensitivity to the receptor area without affecting the main sensitivity of the donor finger, which motivated us to evaluate the results of its application taking into account age, sex, type of amputation, production mechanism, occupation

and time of evolution and incorporation to work. The main complications of surgical treatment were also determined.

The objective of our research is not to compare methods but to present the results of our experience since the procedures that we apply, in addition to providing adequate skin coverage, provide a satisfactory protective sensitivity to the receiving digital pad.

## Material and Methods

The universe of the study was made up of patients with complex loss of substance from the digital pad of the long fingers of the hand from consultations at the "Hermanos Ameijeiras" Clinical-Surgical Hospital. The sample consisted of 33 patients with complex loss of substance from the long fingers of the hand with surgical criteria of monopodicular neurovascularized homodigital flaps on an island, applying direct circulation flaps to 17 patients (Fig. 1) or indirect circulation to 16 patients (Fig. 2).



Caso operado en el Hospital Clínico Quirúrgico Hermanos Ameijeiras

Figure 1: Direct circulation neurovascularized homodigital flap.



Caso operado en el Hospital Clínico Quirúrgico Hermanos Ameijeiras.

Figure 2: Indirect circulation neurovascularized homodigital flap.

### Inclusion criteria.

1. Patients over 18 years of age.
2. Patients with lesion of the digital pulp with loss of complex substance from the long fingers of the hand (2nd to 5th fingers), zone 2 and 3 of Merle and Dautel.
3. 6-month postoperative follow-up.
4. Acceptance by the patient of the surgical treatment.

### Exclusion criteria.

1. Patients with thumb injuries.
2. Patients who refuse surgical treatment.
3. Patients who do not attend scheduled consultations.
4. Patients who voluntarily wish to leave the study.

### Criteria for interruption or exit.

1. Patients who abandon outpatient follow-up.
2. Patients who do not comply with medical indications.

### Variables

Age, sex, production mechanism, occupation, type of amputation (Obliquity of the cut), interval between injury-operation, surgical technique, incorporation to work and complications.

The evaluation of the results was carried out according to the Excellent, Good, Fair and Bad scales, taking into account: necrosis of the flap, protective sensitivity, discrepancy of two static points (S2PD), discrepancy of two dynamic points (M2 PD), hypertrophic scar in the borders of the donor area, pain, retractable surgical wound scar, total active flexion (total active motion) of the interphalangeal joints (TAM), flexion or extension contracture of the proximal metacarpophalangeal and interphalangeal joints, stiffness and patient satisfaction.

### Procedures

#### General

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

#### Specific

Direct circulation monopediculate neurovascularized island flap homodigital.

The island is drawn at the distal end of the affected finger to be used to cover the skin defect, a mid-lateral incision is made on the radial side if the affected one is the 2nd or 3rd finger, and the ulnar side if it is the 4th or 3rd finger. 5th. The island flap is released from the flexor sheath. When sectioning the medial side of the flap, it is advisable to carefully haemostasis the arterial vascular arch of the pulp. The perivascular fatty

environment of the pedicle must be preserved. The pedicle dissection can be carried proximally up to the level of the commissure. The two anastomotic arches of Edwards must be located and electrocoagulated in the vicinity of the distal metaphysis of the first and second phalanges. The advancement obtained is the product of pedicle dissection and flexion placement of the interphalangeal joints. A flap is placed in the receptor site, fixing it with a percutaneous needle, it will be removed when the flap is sutured with simple stitches, as well as the rest of the surgical wound. The donor site is grafted using intermediate thickness skin, taken from the hypothenar eminence.

Indirect circulation monopediculate neurovascularized island flap homodigital.

The island is drawn at the proximal end of the affected finger (palmar aspect of the first phalanx) that is to be used to cover the skin defect, medial-lateral incision is made on the radial side if the affected finger is the 2nd or 3rd finger and ulnar side if it is the 4th or 5th. After determining the necessary length of the collateral nerve for the flap defect, it is sectioned in the palm, leaving a stump of the nerve surrounded by palmar adipose tissue. The palmar collateral artery is in turn divided between two ligatures on the proximal edge of the island flap. Dissection continues from proximal to distal, individualizing the pedicle, away from the pedicle elements. The dissection is stopped before reaching the neck of the second phalanx, so as not to damage the anastomotic arch that will feed the flap with reverse circulation. The flap is rotated to cover the skin defect. Microsurgical suture is made between the distal end of the healthy contralateral digital nerve and the flap nerve. The flap is sutured with simple stitches at the level of the loss of substance and then the donor site in the first phalanx is grafted using a total skin graft.

### Statistical Analysis

In the statistical analysis, summary measures were used for qualitative variables such as percentages and for quantitative variables the mean and standard deviation.

Due to the small sample sizes, the non-parametric Kruskal-Wallis test was used to compare the means of age according to the surgery result, with a significance level of 0.05.

### Results

The most affected age group was between 36-41 years, 10 patients (30.3%) followed by those > 41 years, nine patients (27.3%). Average age was 37.3 ± 10.3 years

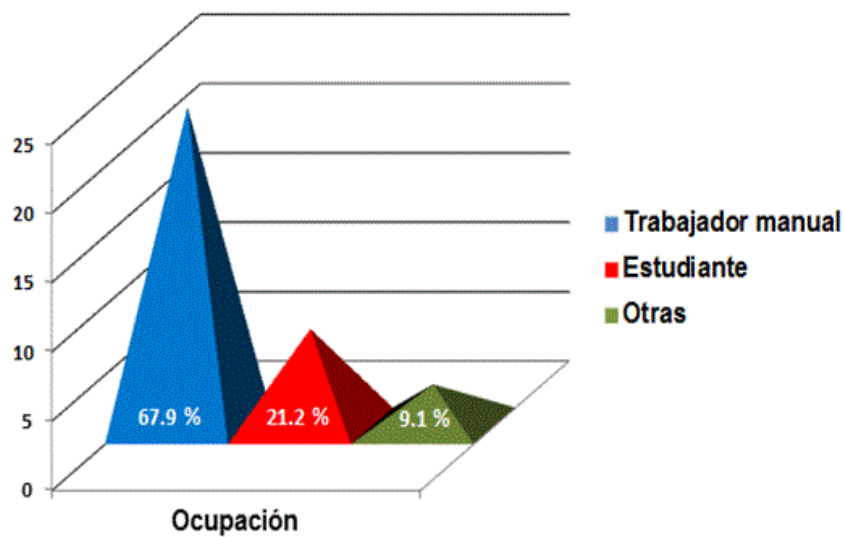
According to the production mechanism, the project showed that the most frequent mechanism was crushing, represented by 23 patients constituting 69.7%. (Table 1)

Mecanismo de producción	#	%
Aplastamiento	23	69.7
Heridas incisivas	9	27.3
Mordeduras	1	3.0
Total	33	100

**Table 1.** Distribution according to production mechanism.



Regarding the occupation of the patients, the most affected were manual workers, 23 patients (69.7%). (Figure 1).



**Graph 1.** Distribution of patients according to Occupation

In the series studied, the transverse lesion of the soft foot prevailed, represented by 21 patients (63.6%). (Table 2)

Tipo de amputación	#	%
Oblicua radial	2	6.1
Oblicua ulnar	3	9.1
Oblicua palmar	7	21.2
Transversa	21	63.6
<b>Total</b>	<b>33</b>	<b>100</b>

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

Regarding the time elapsed between the injury and the surgery, the patients operated after 72 hours predominated, 27 patients (81.8%). (Table 3).

Intervalo lesión operación.	#	%
Antes de 24 horas	2	6.1
24-72 horas	4	12.1
>72 horas	27	81.8
<b>Total</b>	<b>33</b>	<b>100</b>

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

Regarding incorporation to work or usual activities in our series, (Table 4) the group of patients incorporated to their usual activities between 4-6 weeks predominated, 23 patients (69.7%).

Incorporación al trabajo	#	%
< 4 semanas	-	-
4-6 semanas	23	69.7
7-8semanas	7	21.2
> 8 semanas	3	9.1
<b>Total</b>	<b>33</b>	<b>100</b>

**Table 4.** Distribution of patients according to incorporation to work.

Regarding the final results of the investigation, 24 patients (72.7%) obtained Excellent and Good results. The two patients (6.1%) with poor results presented: 1-) total necrosis of the lame, it was a diabetic patient with more than 30 years of evolution, hypertensive and smoker of more than one box of daily cigarettes 2-) rigidity in flexion of the proximal interphalangeal joint due to lack of physical therapy and poor patient cooperation (Table 5)

Resultados	#	%
Excelente	8	24.2
Bueno	16	48.5
Regular	7	21.2
Malo	2	6.1
<b>Total</b>	<b>33</b>	<b>100</b>

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

There were 4 complications (12%). The first complication was total necrosis of the flap in a 55-year-old patient, a diabetic with more than 30 years of evolution, hypertensive, and a smoker of more than one box of cigarettes a day. To solve it, we had to perform necrectomy and targeted healing, but the patient lost the possibility of a more adequate skin coverage and a satisfactory protective sensitivity, so he was also unsatisfied as described above. The second complication was a stiffness in flexion of the proximal interphalangeal joint due to lack of physiotherapy and poor patient cooperation, which was resolved with a second surgical procedure where we sectioned the retinacular ligaments

on both sides of the proximal interphalangeal joint and also the lateral recesses of the the plate fly. The third complication was partial necrosis of the flap in another 57-year-old patient, a 13-year-old diabetic and alcoholic. Surgical debridement and targeted healing were also performed, but as the necrosis was partial, the rest of the flap showed adequate coverage with satisfactory protective sensitivity without affecting patient satisfaction. The fourth complication was a parrot-beak deformity in a 30-year-old male patient, a baker, who despite the deformity was satisfied because his main objective was to resolve the skin defect with satisfactory protective sensitivity. (Table 6)

Complicaciones	#	%
	n=33	
<b>Necrosis parcial del colgajo</b>	1	3.0
<b>Necrosis total del colgajo</b>	1	3.0
<b>Rigidez articular ( MF, IFP, IFD)</b>	1	3.0
<b>Otras</b>	1	3.0
<b>Total</b>	<b>4</b>	<b>12</b>

Table 6. Patients according to complications.

## Discussion

According to the literature consulted, these age groups are more likely to present these injuries because in these stages people are more active at work. ([1,2,6] In the fourth decade of life there is a work experience that brings greater confidence when handling work instruments, which causes non-compliance with protection measures. They also decrease the individual's physical aptitudes, such as: visual deficit, incoordination of fine manual movements and a decrease in the ability to react to dangers.

Digital pulp lesions were more frequent in males, represented by 27 patients (81.8%). Coinciding with the series by Adani et al. [7, 11, 20] It is based on the fact that men perform manual activities of greater risk compared to women.

Due to the great industrial development and the incorporation of multiple complex heavy machinery, crush trauma and blunt avulsive wound are more frequent than incised wounds and bites. Frank Fang et al. [9, 10, 13] and Carlos E. [8, 13] agree with our report.

With the increase in industry and the mechanization of work tools, the manual worker, by the nature of his trade, traumatizes his hands. Hands top the list for industrial workplace accidents and are responsible for much of the compensation costs. [1, 3, 15] French annual statistics report 360,000 hand accidents (32% of work accidents). [17, 18, 19, 21]

Frequently, the production mechanisms that cause these injuries contribute to great contamination of the wounds that also occasionally become well established around 72 hours. Godina [4] recorded an incidence of infection of 1.5% using a protocol of excision of the lesion and skin coverage by microsurgery in 72 hours and an incidence of infection of 17.5% with the closure of the wound in less than 72 hours. Lister and Schoker [4] presented satisfactory results using skin coverage through the use of flaps in the 24 hours following the injury. Brenner et al. They did not observe significant differences in infection rates when they compared emergency primary transfer of free and / or vascularized tissue versus delayed primary or secondary transfer. Delayed treatment allows the injury to be evaluated a second time, verifying the viability of the limb in order to plan the intervention more precisely. However, in our series, no infection was found before or after 72 hours. [4, 12, 16]

Bunelli F. [14, 15, 22] demonstrated in her research that the described incorporation fluctuated between 5-6 postoperative weeks, while the cases incorporated in the two series after eight weeks were those that presented 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 and the results obtained in the present investigation. S. Rojas Sabapathy and Godina [4] demonstrated excellent results with the use of homodigital neurovascularized flaps in covering the loss of complex substance from the pulp.

According to Merle [3, 5] the most frequent complications are: total and partial necrosis of the flap and stiffness of the metacarpophalangeal, proximal and / or distal interphalangeal joints, coinciding with what has been reported by several authors. The study yielded similar results to those obtained in the literature.

## Conclusions

- The age groups most likely to present complex loss of substance from the digital pulp were middle-aged, predominantly males.
- The most frequent production mechanism was crushing.
- Manual workers were the ones that damaged their hands the most.
- The incorporation of the patients to their usual activities was between 4-6 weeks.
- The most frequent complications were: total and partial necrosis of the flap and stiffness in flexion of the proximal interphalangeal joint.
- Excellent and good results predominated in the younger age groups: 18-23 and 24-29 years respectively and in the group of patients without risk factors.
- Similar satisfactory (excellent and good) results were obtained with the application of both homodigital neurovascularized flaps.

## References

- 1 Albaladejo F. (2003) Cutaneous coverage of the ball of the fingers of the hand. 3rd Edition. Madrid: Editorial: Jarpyo Editores. P 36-54, 106-215.
- 2 Coiffman. (2008) Plastic, reconstructive and aesthetic surgery, surgery of the hand and upper limb. Vol. V. 3rd edition. Colombia: Editorial Amolca. P 111-152.
- 3 Merle M, Dautel G, Loda G. (2005) Traumatic hand emergencies. Madrid: Editorial: Jarpyo Editores. P 201-222.



- 4 Campbell. (2013) Campbell's Operative Orthopedics: Eleventh Edition. Philadelphia, Pennsylvania: Editorial S. Terry Canale, MD. P 155-178.
- 5 Llorente Pendás JL. (1997) Free flaps in head and neck reconstructions. Madrid: Editorial Garsi, S.A. p 121-123.
- 6 Masquelet C A, Gilbert A. (2001) An atlas of flaps of the musculoskeletal system. 1st Edition. Editorial Taylor & Francis Group. 132-140.
- 7 Masquelet, A.C and A. Gilbert (1995): An Atlas of Flaps in Limb Reconstruction. 2nd Edition. London: Publisher: Martin Dunitz Ltd, 2001.
- 8 Masquelet, A.C and A. Gilbert (1992): Cover flaps in the lower extremity. Springer-Verlag Ibérica, SA.
- 9 Loda G. (1999) Atlas of thumb and finger reconstruction. 3rd Edition. New York: Editorial Thieme Stuttgart.
- 10 Dunitz M. (1997) Reconstructive surgery in hand mutilation. 2nd Edition. Barcelona: Editorial: Printed and bound in Spain by Grafos S.A. Art on paper.
- 11 Boscheinen MJ, Bruce Conolly W. (2001) The hand: Fundamentals of therapy. Third edition. Publisher Butterworth Heinemann. P 156-160.
- 12 C. Chung K. (2011) Reconstruction of the hand and upper limb. 1st Edition. Colombia: Editorial Amolca. 162-173.
- 13 Ballester, R. (2012) (1997) Losses of substance; A challenge in traumatology and orthopedic surgery. 1st Edition. Madrid: Editorial MAPFRE MEDICINA. 107-122.
- 14 López, B. R and R. Hernández Gutiérrez. (2006) Latissimus dorsi flap Essential technique in reconstructive surgery of the upper limb.
- 15 Montealegre G. (2007) The traumatized hand, fingertip wounds, skin coverage and infections and primary care in hand trauma. Guidelines for Plastic Surgery Clinics of the Hospital de San José. Bogotá: University Foundation of Health Sciences.
- 16 Torres F. C. E, Hernández B. J.A, Castañeda H. D. A Initial management of fingertip injuries: treatment guide based on experience at Hospital San José.
- 17 Blanco P. H, Pereda C. (2000) Local flaps in the emergency treatment of distal amputations of the fingers. Rev Cubana Ortopedia y Traumatología vol.14 no.1-2 Havana.
- 18 Edmonson A, Crenshaw A. (2000) Microsurgery. Orthopedic surgery: Panamericana.126-143.
- 19 Dautel G. (1995) Skin coverage. Free flaps. Traumatic hand. 2nd ed. Barcelona: Masson; p 114-139.
- 20 Browne Earl Z. (1992) General principles in the treatment of skin lesions. In: Mc Carthy Joseph G. May James. Editor. Plastic surgery. Hand. Volume 1 Madrid Spain. Editorial Médica Panamericana. SA. 197-207.
- 21 Lakshmanan P. Amputation, Fingertip. Medscape.
- 22 Sastre R. (2003) Hand wounds. Guidelines for emergency management. Bogotá: Ministry of Social Protection.



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