

The Digital Neurovascular Island Flap Applied In Acute Injuries

João Recalde, MD¹
Pedro Bijos, MD²

- 1] Staff Member, Microsurgery Division – HTO – MS – Rio de Janeiro
Staff Member, Clínica SOS Mão – Rio de Janeiro
Titular Member, SBCP
- 2] Chief, Microsurgery Division – HTO – MS – Rio de Janeiro
Staff Member, Clínica SOS Mão – Rio de Janeiro
Titular Member, SBCP

Clínica SOS Mão

Rua São João Batista, 80 – Botafogo
22270-030 – Rio de Janeiro – RJ – Brazil
Phone/Fax: +55 21 266-6004

ABSTRACT

The authors present 20 cases of digital neurovascular island flaps applied in acute injuries. Sixty-one patients treated over the last 3 years of severe digital tissue loss were analysed. 70% of cases were sited at the distal phalanx. Eight patients were treated with direct island flaps to restore skin and sensibility of small oblique distal losses. Seven patients presenting more transverse and extensive lesions needed reverse flow island flaps. Three patients with partial pulp amputation of the thumb were treated with island bipediced flaps. Finally, in the other two patients with total loss of thumb pulp, heterodigital island flaps with neurotization of the flap were necessary to restore the thumb whole digital pulp. The functional and aesthetic aspects of the reconstructions were analysed and compared with the traditional methods.

INTRODUCTION

Small tissue losses involving the digital distal segment are quite frequent. The covering method must be elected on account of innumerable criteria. All methods, however, must have in common the skin and subcutaneous tissue replacement for a tissue presenting the same characteristics and sensibility. Such an ideal situation is achieved only if the skin adjoining to the defect is used. The defect topography, the affected finger, the associated lesions of the injured finger and of the neighbouring fingers, the post-operative re-education, the functional necessities, the patient's age and sex, all these factors interfere in this therapeutic choice.

All covering techniques, from the simple directed healing to the microsurgical transplantation, must be known in detail, aiming at providing the patient with the most adequate answer. The practice of small local flaps, however, requires a deep knowledge of the hand vascularization.

In this work, the utilization of flaps vascularized by the digital colateral artery for covering tissue losses of the long fingers and thumb will be analysed. The use of these flaps was introduced in 1955 by Moberg⁽⁵⁾ and made popular by Littler⁽⁴⁾ and Tubiana⁽⁶⁾. Differ-

ent island flaps, both homodigital and heterodigital, were described. They are particularly indicated in the digital pulp reconstruction, which requires a consistent, sensible and good looking covering.

There are two types of homodigital island flaps applicable to fingers: 1 – direct island flap, described by Venkataswami and Subramanian in 1980⁽⁷⁾ from the initial works by Hueston in 1966⁽³⁾; 2 – reverse flow island flap, described by Glicenstein⁽²⁾ and Brunelli⁽¹⁾.

As to the heterodigital flaps, indication is basically restricted to those cases of extensive loss of thumb digital pulp, where the distal phalanx ulnar rim of the annular finger is used as donor site for the cutaneous covering.

MATERIAL AND METHOD

In 19 patients of the total 61 cases of traumatic tissue loss in long fingers and thumb treated between 1991 and 1994 at the Clínica SOS Mão, 20 digital collateral artery flaps were utilized.

Sixty-five per cent of the cases were represented by the digital collateral artery flap of proximal flow. On the long fingers, the flap was outlined having as axle one of the palmar neurovascular pedicles. When the case referred to losses of the finger itself, the flap distal limit was the lesion rim itself. In the heterodigital reconstructions (eg. thumb), however, the flap included the whole hemipulp. Depending on the loss extension, it proceeded proximally as far as the median phalanx. The lateral limits were the median line of the volar face and the median-lateral line, laterally.

The dissection was performed under pneumatic tourniquet and the flap was raised from the deep plan always next to the digital channel. A lateral incision connecting the interdigital plicae extremities, as far as the finger base or even more proximally on the palm, permitted to approach the neurovascular pedicle. After releasing the pedicle, the flap was advanced to the distal loss or transposed to another finger by means of tunnelization, when the case required it.

The donor site was covered with a total skin graft and the finger was kept under slight flexion to prevent tensioning the pedicle.

On the thumb, the flap was utilized from both neu-



Fig. 1 – Partial tissue loss of a right thumb pulp in a 4-year-old child.

Fig 1 - Perda de substância parcial da polpa de um polegar direito em uma criança de quatro anos.

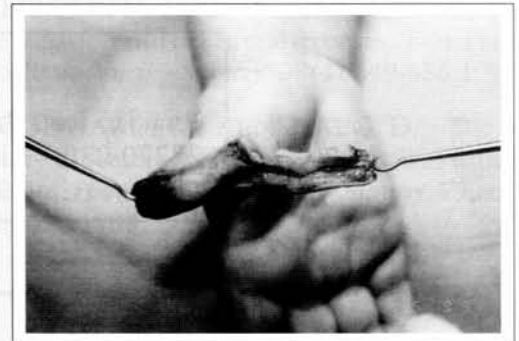


Fig. 2 – The bipediced homodigital flap is dissected to permit the advancement to the loss site.

Fig 2 - O retalho homodigital bipediculado é dissecado para permitir o avanço em direção à perda.



Fig. 3 – The result of 6 post-operative months shows adequate accommodation of the flap skin and graft at the donor site.

Fig 3 - O resultado com 6 meses mostra boa acomodação da pele do retalho e do enxerto na área doadora.

rovascular pedicles (O'Brien), permitting the total advancement of the volar skin to the distal loss site (Fig. 1). The marking was performed in quadrilateral

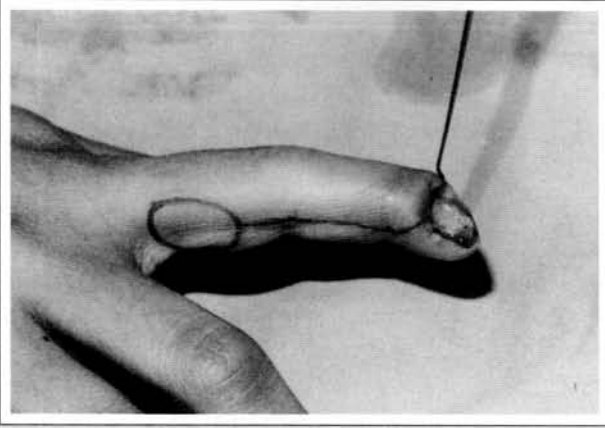


Fig. 4 - Marking of the reverse flow island flap at the ulnar rim of the proximal phalanx to cover dorsal osseous exposure of the distal phalanx. The pedicle is accessed by means of a median-lateral incision from the donor site as far as the cutaneous loss site.

Fig 4 - Marcação do retalho em ilha de fluxo reverso no bordo ulnar da falange proximal para cobrir exposição óssea dorsal da falange distal. O pedículo é abordado por incisão médio-lateral desde a área doadora até a perda cutânea.

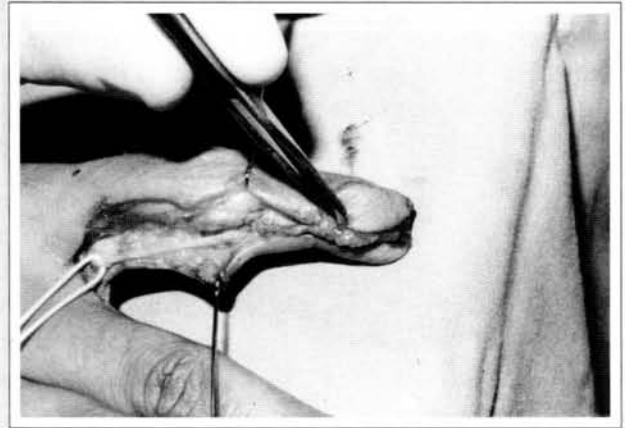


Fig. 5 - After dissection of the vascular pedicle without the nerve, the flap is transposed to the receptor bed. Observe that the pedicle dissection must not go beyond the distal third of the median phalanx to prevent sacrificing the last transverse branch which communicates with the contralateral pedicle.

Fig 5 - Após a dissecação do pedículo vascular sem o nervo, o retalho é transposto até o leito receptor. Notem que a dissecação do pedículo não deve ultrapassar o terço distal da falange média para não sacrificar o último ramo transverso que se comunica com o pedículo contralateral.

form, having as proximal limit the median portion of the proximal phalanx and as lateral limit the median-lateral lines of either side. The pedicle was accessed by means of an ample detachment of the proximal skin, permitting the release and advance of the flap under no tension (Fig. 2). The donor site was treated likewise, and the whole finger was kept under slight IF flexion. The final result was always satisfactory (Fig. 3).

The digital collateral artery flap of reverse flow was marked on the proximal phalanx of the finger to be reconstructed (Fig. 4). Its limits were the median and lateral axle of the finger and the flexion plicae proximally and distally. When the flap was indicated for covering but did not require sensibility, it was transposed only with the vascular pedicle (Fig. 5). In such a case, care was taken to keep the greatest possible amount of adipose tissue around the pedicle to prevent venous suffering problems. The losses treated with this kind of non-resensibilizable flap were generally sited on the dorsum of the median and distal phalanx (Fig. 6). As to the larger losses of the distal phalanx (Fig. 7), the flap was transposed with the collateral nerve to be resensibilized from the contralateral nerve. The flap was initially approached and the neurovascular pedicle was proximally identified, with the care

of preserving the dorsal branch of the collateral nerve which originates next to the digital-palmar plica; the nerve was then dissected palmward 1 cm from the flap rim and sectioned. Then a median-lateral incision as far as the tissue loss site permitted the pedicle dissection, which did not go beyond the digital plica of the IFD (Fig. 8).

The flap was then transposed to the tissue loss site, with care being taken only to prevent torsioning and tensioning the pedicle. After suture of the flap and donor site of access to the vessels, the collateral nerve previously dissected was finally sutured with the proximal stump of the flap nerve (Fig. 9). The donor site was grafted with total skin.

RESULTS

The traumatic tissue losses of long fingers and thumb treated with digital collateral artery flaps represented only 30% of the total 61 patients assisted over the last three years.

The most common causes of the accidents were domestic (40.9%), work (22.95%), street and road (11.5%) and sport (6.54%). The most affected fingers were the forefinger (33.84%), the middlefinger

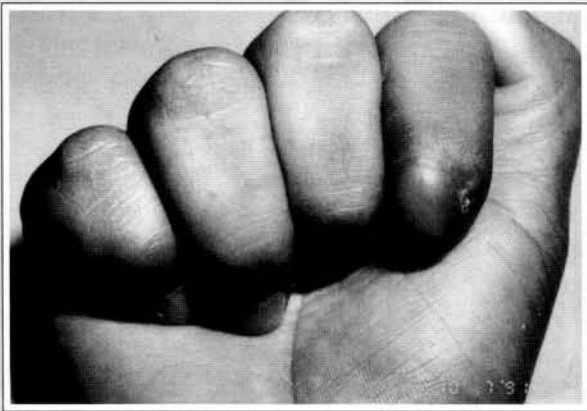


Fig. 6 - Result after 3 post-operative months, with good aesthetic aspect of the reconstructed area.

Fig 6 - Resultado após 3 meses com boa aparência estética da área reconstruída.

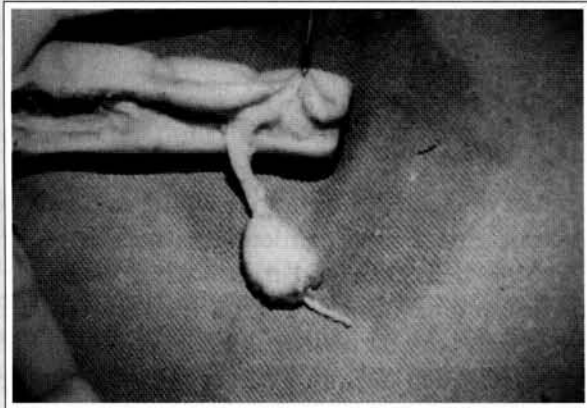


Fig. 8 - Reverse flow island flap dissected along with the collateral nerve. Observe that the proximal stump was sectioned at 1 cm from the flap rim, to permit the neuroorrhaphy with the contralateral nerve.

Fig 8 - Retalho em ilha de fluxo reverso dissecado juntamente com o nervo colateral. Notem que o coto proximal foi seccionado há 1 cm da borda do retalho para permitir a neurorrafia com o nervo contralateral.

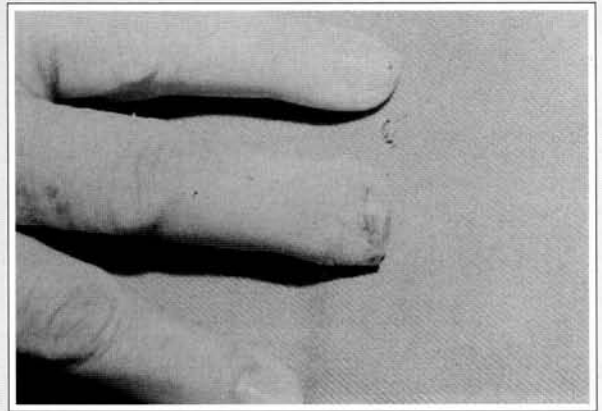


Fig. 7 - Transverse amputation at the level of the median third of the distal phalanx with loss of a considerable portion of the ungual bed.

Fig 7 - Amputação transversa a nível do terço médio da falange distal com perda de boa parte do leito ungueal.



Fig. 9 - Result after one post-operative year, showing the ungual bed recovering with the filling of the fingertip with the flap. The flap was satisfactorily resensitized.

Fig 9 - Resultado após 1 ano onde se verifica a restituição do leito ungueal com o enchimento da ponta do dedo com o retalho. O retalho foi resensibilizado satisfatoriamente.

(24.61%), the annular (21.53%), the minimus (10.76%) and the thumb (9.23%). The right hand, being the dominant one in the majority of the population, was involved in 57.37% of the cases, compared to 42.63% of occurrences on the left hand. In 73.35% of the cases there was no association with other lesions, but only the tissue loss itself, while in the remaining 26.7% the lesion was associated with fracture (13.3%), devascularization (5%), sinews and nerves section (3.3%) and other occurrences (3.3%).

The dimensions varied depending on the loss exten-

sion and the patient's age, but they generally did not go beyond one third of the finger total length in the unipedicled flaps and 50% of the volar surface in the bipedicled ones (O'Brien).

Complications represented up to 15% of the cases (3 cases); in 10% there was total loss of the flap and, in the remaining 5%, partial loss. In those cases, the lesion extension was probably inadequately evaluated, and the vascular pedicle might have been already affected. All of those cases occurred in the reverse flow flap.

DISCUSSION

Innumerable techniques of digital tissue loss covering have been described and are successfully utilized nowadays. The indication of more complex surgical procedures is dominant when there is osseous exposure. The osseous covering provided by direct suture or cutaneous grafting produces unsatisfactory results and the cutaneous flap is preferable. When there is minimal osseous exposure, the covering with local advance flaps is possible (Hueston 1966, Tranquilli-Leali 1935 and Tubiana 1986), but the larger the cutaneous loss area, the more complex the procedure. Until recently the most extensive cutaneous losses were covered with flaps distant from the temporary pedicle (cross-finger or thenar flap). This resulted in fingers with good aspect but with no sensibility, aesthetic sequela of the donor site and risk of articular rigidity due to the extensive immobilization period (generally three weeks). Nowadays the indications for this kind of flap became less common due to the development of island flaps, a technique which permits reconstruction in a single surgical time. The choice is essentially made between two types of island flap. The choice between the two techniques depends on the patient's clinic status and the surgeon's experience. As a general rule, the transverse or slightly oblique amputations are better treated with advance local flaps. The oblique amputations, where the amputation line ends at the median portion of the distal phalanx are preferably treated with direct island flaps. In all remaining cases, the reverse flow flap must be indicated.

The problems which affect this kind of flap are basically the retractile median-lateral scar with [?] IFP [?] flexion, which may be corrected with z-plasty and physiotherapy; the flap hyperesthesia, which tends to decrease on the first months, and the cutaneous anesthesia at the proximal areas which are always denervated with the pedicle dissection.

However, the advantages are evident as compared with other alternatives. This flap provides a covering in a single surgical time, with good quality and sensibility, permitting the maximum preservation of the finger length.

In reverse flow flaps, the neurotomy of one of the collateral nerves with the contralateral nerve is possible, thus preventing one of the greatest problems with the amputation stumps, which are the neuromas. In addition, it permits the transposition of a large skin segment with reinnervation possibility.

REFERENCES

1. BRUNELLI, F. 1987 – Lambeau en îlot digital inversé. *Pages at GEM winter meeting*, Paris.
2. GLICENSTEIN, J. 1988 – Table ronde: Les lambeaux en îlots en chirurgie de la main. *Annales de Chirurgie de La Main* 7:119-121.
3. HUESTON, J. T. 1966 – Local flap repairs in the finger tip injuries. *Plastic and Reconstructive Surgery* 37:349-350.
4. LITTLER, J. W. 1956 – Neurovascular pedicle transfer of tissue in reconstructive surgery of the hand. *Journal of Bone and Joint Surgery* 38A:917.
5. MOBERG, E. 1964 – Aspects of sensation in the reconstructive surgery of the upper extremity. *Journal of Bone and Joint Surgery* 46:817-825.
6. TUBIANA, R.; DUPARC, J. 1959 – Operation palliative pour paralysie sensitive à la main. *Memoires de l'Academie des Chirurgiens*. 85:66-670.
7. VENKATASWAMI, R.; SUBRAMANIAN, N. 1980 – Oblique triangular flap: a new method of repair for oblique amputations of the fingertip and thumb. *Plastic and Reconstructive Surgery* 66:296-300.