

# Reconstruction of the loss of substance of the dorsum of the hand: from the conventional techniques to regenerative surgery procedures



*Ann. Ital. Chir.*, 2012 83: 125-128

Chiara Calzoni, Alessandra Pica, Marcello Desgro, Elisabetta Pataia, Carmine Alfano

*Cattedra di Chirurgia Plastica e ricostruttiva, (Direttore: Prof. Carmine Alfano), Università degli Studi di Perugia, Italy*

## Reconstruction of the loss of substance of the dorsum of the hand: from the conventional techniques to regenerative surgery procedures

**AIM:** *Our aim is focused on the advantages of new technologies compared with those of traditional methods in the reconstruction of the loss of substance of the dorsum of the hand.*

**MATERIAL OF STUDY:** *We observed 37 patients from 2007 to 2010 with loss of substance of the dorsum of the hand, also associated with significant comorbidities. In 27 patients we chose surgical reconstruction, in 10 patients we opted for conservative reconstruction with the use of new technologies.*

**RESULTS:** *After a median follow-up from one to three years, in all cases the skin coverage was reinstated and mobility was restored, thereby adhering to the principles of both morphological and functional reconstruction.*

**DISCUSSION:** *Concerning reconstruction by means of flaps, the main principles dictate is the new coverage must appear as much as possible, similar to the original tissue. The reconstruction must be in a single surgical time. On the other hand, the advent of advanced dressings and bioengineering has optimized conservative skin repair.*

**CONCLUSIONS:** *We have seen a considerable broadening of the indications for conservative reconstruction. This method is suitable for reconstruction of the dorsum of the hand with good effectiveness, it makes it possible to obtain a tissue of good quality, which is flexible and smooth on the tendons and is not excessively thick. These methods are achieved with relative ease even in patients with poor general health. Although costly, this procedure will ultimately save the patient from further surgeries and hospitalization expenses, making it advantageous when considering the benefit-cost ratio.*

**KEY WORDS:** Bioengineering, Dorsum of the hand, Flap

## Introduction

The skin of the dorsum of the hand has unique anatomical properties closely related with the function of excursion of the metacarpophalangeal joints.

Thin and supple, the dorsal skin of the hand is tenuously connected to a small amount of subcutaneous loose connective tissue, which enables the smooth flow of the integument on the dorsal extensor tendons due to a low coefficient of friction between the tissue surfaces.

These properties allow the skin of the back of the hand to adapt passively to the positions of flexion-extension movements of the wrist and metacarpophalangeal joints, as evidenced by the typical transverse folds, performing the dual function of protection of the extensor of the hand and the participation of the active sliding mechanism of the extensor tendons.

*Pervenuto in Redazione Maggio 2011. Accettato per la pubblicazione Settembre 2011*

*Correspondence to: Dr. Chiara Calzoni, Strada Gualtarella 1/C, 06127 Perugia, Italy (e-mail: chiaracalzoni@gmail.com).*

The natural position of the dorsum of the hand, commonly turned outward during the task of grasping, determines the exposure to traumatic agents and explains the high incidence rate in this anatomical region of injury from crushing and tearing, characterized by extensive loss of skin or tendon substance with exposure to eventual metacarpal fractures.

The result is a difficult problem of reconstruction, several solutions have been proposed in literature regarding both island and free flaps.

In any case, the goal which must be reached is the early mobilization.

However, treatment of bone and tendon injuries in urgency does not make sense unless it ensures, as of this stage, an impeccable skin coverage which is capable of protecting the underlying structures.

In severe cases, of complex trauma by crushing, the time of revascularization is a necessary preliminary step.

In addition, to determine when to perform the various interventions regarding skin coverage, a thorough surgical cleansing is necessary to ensure the elimination of all necrotic tissue and a knowledge of the different donor sites. This is crucial to ensure that any loss of substance necessitates the most appropriate solution, taking into account, step by step, any local conditions as well as the functional needs of the patient and paying close attention to limit the sequelae at the donor site.

The surgical treatment should strive for reconstruction of the dorsum of the hand which will facilitate the objective of restoring skin coverage, but at the same time express a "functional reconstruction", ie to associate the reintegration of the loss of skin substance with the ability to restore and protect the core functions performed by the integument of the back of the hand, with particular attention to the functions of "protection", to "sliding of the extensor" and "motion of the metacarpophalangeal joints."

The therapeutic cache on cover strips has been greatly expanded over the past 20 years. Regarding losses of substance of the back of the hand, the literature offers various solutions ranging from the pedicled flap to the free flap. In addition, the increasingly emerging use of advanced dressings and techniques of bioengineering, innovative treatment options are becoming more and more common in our daily practice.

## Materials and methods

From January 2007 to March 2010, we performed 37 reconstructions of the back of the hand.

The cases that came under our observation have diverse aetiologies: 7 patients with malignant disease, 26 patients with traumatic disease, and 4 with infectious disease.

The information on the mechanism of trauma was a prerequisite to the choice of appropriate treatment.

In the 7 patients operated on for malignant disease, and

1 patient operated on for infectious disease, the reconstruction was performed by using primary closure (5 cases) or local flaps (3 cases).

Of 10 cases of traumatic injuries with superficial loss of skin substance, healing was achieved using guided healing, advanced medications, and / or dermal substitutes in 4 cases (Fig. 1), use of VAC therapy in 3 cases and cell cultures in 3 cases (Fig. 2).

In the remaining 19 cases reconstructions were performed with pedicled flaps, of which 4 patients were treated with a reverse radial flap, 2 with a radial perforator flap, 6 with a posterior interosseous flap, 3 with an ulnar flap, 1 with a pre-expanded groin flap, and 3 with a Becker-Gilbert flap.

All patients were subjected to a treatment of early functional rehabilitation as soon as the skin repair allowed the maneuvers of mobilization and manipulation.

As for the conservative treatment, the only complication that we encountered was a partial removal in 1 case of plant cell culture of autologous keratinocyte, which necessitated an additional subsequent implantation.

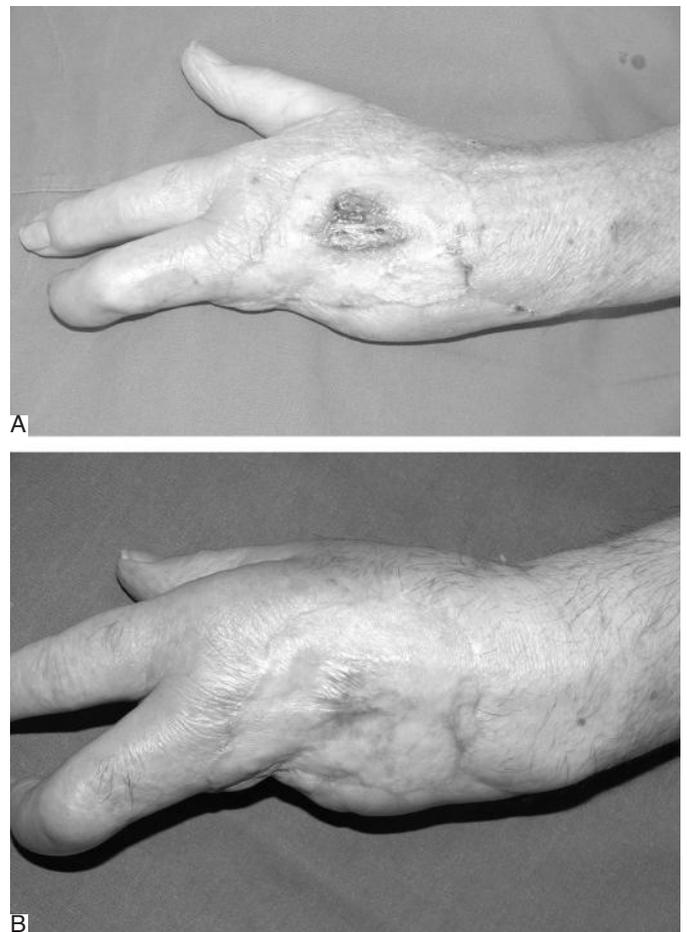


Fig. 1: A) Traumatic loss of substance in a 70 year old patient with hypertension and heart disease. B) Result at 3 months after application of Integra®.



Fig. 2: A) 48 year old woman, with hand burns in a denervated limb. Treatment of keratinocytes with cell culture. B) Result some time after application of keratinocytes cell culture.

In the pedicled flap reconstructions we observed post-operative venous stasis in 1 case of posterior interosseous flap, resolved with the application of leeches, and 1 case of ulnar antebrachial flap with a partial loss of the flap. In one case of posterior interosseous flap we encountered a posterior interosseous artery anatomical variation that forced us to turn the flap on the perforated side of the anterior interosseous, the flap experienced regular progress without complications.

## Results

The follow-up ranges from one to three years. In all cases the limb was preserved and we achieved good functional recovery.

In all the treated cases the primary objective pursued was that of early mobilization.

This objective was achieved in almost all cases, which is consistent with the initial disease and the complications described.

## Discussion

The elasticity of the skin of the dorsum of the hand allows for the implementation of primary closure and local flaps closeby to cover most of the smaller losses of substance. The advent of new technologies has led to an optimization of the conservative management of injuries.

Thus we have seen a significant expansion of the indications for reconstruction led by healing and/or skin grafts.

These methods lend themselves to the reconstruction of the dorsum of the hand and they prove effective in obtaining good quality tissue which is flexible and smooth on the tendons without being excessively thick. These methods are practicable with relative ease even in patients with poor general health. Although costly, this procedure will ultimately save the patient from further surgeries and hospitalization expenses, making it advantageous when considering the benefit-cost ratio.

Concerning reconstruction by means of flaps, we chose, in all cases, the fascio-cutaneous flaps both pedicled and free.

We believe that in this area it is neither necessary nor appropriate to ever use flaps of muscle.

The availability of quality flaps in the forearm renders the use of the free flap to be limited to those cases of complex substance loss or to those of larger dimensions. We believe that the current availability of advanced therapeutic aids will amplify the indications for “conservative” reconstruction. It is also very helpful in preserving donor sites and in treating quickly patients with significant comorbidities.

## Conclusions

The reconstruction of the skin of the back of the hand must prioritize the reconstruction of an integument in order to maintain or restore the function of flexion and extension for both the wrist and the fingers.

The key moment for proper treatment is realized by the injury assessment under which you can set up a treatment protocol which is aimed at obtaining the highest quality reconstruction possible in the shortest amount of time.

Early mobilization is in fact the decisive moment for adequate functional recovery.

The treatment of loss of substance of the tissues lining the back of the hand, irrespective of their etiology, does not aim simply to restore the “coverage” but must be capable of executing a “repair” function, or to associate the reintegration of skin loss with the ability to restore and protect the core functions performed by the integument of the back of the hand with special reference to the functions of “protection”, “scroll extensor”, “mobility of the carpo-metacarpal and metacarpophalangeal” and last but not least the cosmetic function of “organ interaction”.

In our experience, these goals have been pursued with success in certain cases, even by resorting to conservative treatment with the help of new technologies for medication.

We therefore believe that these methods can expand, in effect, the therapeutic cache available to us, without

replacing the traditional methods of reconstruction using grafts or flaps which we believe to be the most important resource especially in complex cases.

### Riassunto

Lo scopo del nostro studio è quello di evidenziare i vantaggi nella ricostruzione delle perdite di tessuti sul dorso della mano, che sono stati introdotti grazie alle nuove tecnologie, paragonandole a quelle dei metodi tradizionali.

La nostra attenzione è stata rivolta a 37 pazienti trattati tra il 2007 ed il 2010 per perdite di tessuti sul dorso della mano in associazione con comorbilità significative.

In 27 pazienti è stato scelto di eseguire ricostruzioni chirurgiche tradizionali, mentre in 10 pazienti si è optato per ricostruzioni conservative mediante l'uso di nuove tecnologie.

Dopo un follow-up da uno a tre anni, in tutti i casi la cute di ricopertura risultava ricostituita con recupero della mobilità, raggiungendo entrambi i principi di ricostruzione morfologica e funzionale.

Per ciò che riguarda la ricostruzione con lembi, i nuovi principi indicano che la nuova ricopertura debba presentarsi il più possibile "simile" ai tessuti originari, e la ricostruzione venga effettuata in una sola procedura chirurgica e solo in un settore anatomico.

D'altra parte l'avvento di tecniche avanzate di medicazione e di bioingegneria hanno ottimizzato la riparazione cutanea conservativa.

In tal modo si è visto un significativo incremento delle indicazioni alla ricostruzione per mezzo plastiche locali e/o innesti di cute.

Questi metodi comportano di per sé, con particolare efficacia, la ricostruzione del dorso della mano, e di fatto offrono un tessuto di copertura di qualità eccellente, flessibile e soffice a livello dei tendini, senza la complicità di uno spessore eccessivo.

Si tratta di metodi praticabili con relativa facilità anche in pazienti in condizioni generali compromesse. Nonostante si tratti di procedure costose, esse mettono il paziente al riparo dalla necessità di futuri interventi chirurgici e spese di ricovero, rendendo vantaggioso il rapporto costi/benefici.

### References

1. Monarca C, Chiummariello S, Rizzo MI, Alfano C, Scuderi N: *Innovative microsurgical device in perforator free flaps surgery*. G Chir, 2009; 30(5):215-17.
2. Chiummariello S, Arleo S, Alfano C: *Aminoacids and hyaluronic acid in topical treatment of bedsores*. G Chir, 2010; 31(5):251-55.
3. Gottlieb ME, Furman J: *Successful management and surgical closure of chronic and pathological wounds using Integra*. J Burns Surg Wound Care, 2004; 3:4-60.
4. Clerici G, Caminiti M, Curci V, Quarantiello A, Faglia E: *The use of a dermal substitute to preserve maximal foot length in diabetic foot wounds with tendon and bone exposure following urgent surgical debridement for acute infection*. Int. Wound J, 2010; 7(3):176-83.
5. Flamans B, Pauchot J, Petite H, Blanchet N, Rochet S, Garbuio P, Tropet Y, Obert L: *Use of the induced membrane technique for the treatment of bone defects in the hand or wrist, in emergency*. Chir Main, 2010; 29(5):307-14. Epub 2010.
6. Drossard G, Potier B, Steff M, Rousseau P, Payement G, Darsonval V: *Optimized negative pressure therapy*. Ann Chir Plast Esthet, 2009; 54(2):165-70. Epub 2009.
7. Wang HT, Fletcher JW, Erdmann D, Levin LS: *Use of the anterolateral thigh free flap for upper extremity reconstruction*. J Hand Surg, 2005; 30:859-64.
8. Myers SR, Partha VN, Soranzo C, Price RD, Navsaria HA: *Hyalomatrix: A temporary epidermal barrier, hyaluronan delivery, and neodermis induction system for keratinocyte stem cell therapy*. Tissue Eng, 2007; 13(11):2733-41.