

# Autologous fat graft: an additional or alternative treatment in the ulcer healing

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## Summary

### Autologous fat graft: an additional or alternative treatment in the ulcer healing

Ulcer is a lesion of the skin characterized by a slow or difficult healing. Considering the etiopathogenetic aspects, we can classify: mechanical ulcers (pressure), vascular (arterial, venous, lymphatic, and autoimmune) and neuropathic ulcers. The subjective symptoms are characterized by pain, refer to shock, accompanied by functional impotence and intermittent claudication. In diabetic neuropathy, pain may be reduced or absent. The skin around it is dry, shiny, thin, atrophic, hairless with thick and sclerotic nails. We have also to consider post-traumatic ulcers, where there is discontinuity of the skin that often exposes the dermis and the subcutaneous fat. They are caused by trauma and can turn into chronic ulcers, due to unfavorable conditions, such as the need for numerous surgeries, infections or inadequate treatments. From September 2009 to November 2011 13 patients (11 suffering from post-traumatic ulcers and 2 patients suffering from vascular ulcers) were treated with autologous fat graft. Follow-up was performed at 2 weeks, 3 months and 6 months postoperatively. In all the patients treated obvious signs of clinical improvement with a clear reduction of the ulcerated area appeared. In 9 patients, we had a complete wound healing. The remaining 4 patients were subjected to further surgical procedures (skin graft). We have never had any complication, neither minor nor major. The adipose tissue promotes the healing process by repairing and replacing the lost tissue. These findings suggest that this treatment can significantly improve the functional features of patients with ulcerative diseases if compared to standard medications and surgery. Particularly, lipostructure of patients with burn scars showed encouraging results concerning texture, softness and thickness of the skin. In conclusion, ulcers are a serious problem for patients causing a marked deterioration in their quality of life. We think that the treatment of post-traumatic and chronic ulcers by fat grafting is yielding encouraging results and could become suitable in many types of ulcers (post-traumatic, vascular, pressure ulcers), as an additional or alternative procedure with low morbidity.

**Key words:** Post-traumatic ulcer, Vascular ulcer, Fat graft, Lipostructure.

## INTRODUCTION

Ulcer is a lesion of the skin characterized by a slow or difficult healing. The ulcer may involve the epidermis, the dermis and underlying ligaments. The causes can be manifold. Considering the etiopathogenetic aspects, we can classify: mechanical ulcers (pressure), vascular (arterial, venous, lymphatic, and autoimmune) and neuropathic ulcers<sup>1-6</sup>. It is defined as a lesion with evolving necrotic tissue, which affects the skin, the dermis and subcutaneous layers, until, in severe cases, muscles and bones.

A lesion decubitus is the direct consequence of a prolonged compression or shear forces (or stretching), causing a mechanical stress to the tissues and the compression of blood vessels, with consequent reduction in blood flow, local ischemia, hypoxia and tissue necrosis. The decreased blood circulation leads to an accumulation of toxic metabolic products with a consequent increase in capillary permeability, vascular dilatation, edema formation. These give rise to inflammatory reactions characterized by hyperemia with increased capillary pressure for which the toxic metabolic products can still be carried on. If, however, the action of compressive or shear forces persists, it will reach an irreversible cell death, with the formation of necrosis due to increased tissue hypoxia.

Arterial ulcers are those trophic lesions of the lower limbs that appear in subjects with arterial disease in which there is a reduction of vessel lumen greater than 50%, or caused by a inflammatory-thrombotic processes (bulgariane ulcers), or by a detachment of emboli (embolic ulcers).

The subjective symptoms are characterized by pain, refer to shock, accompanied by functional impotence and intermittent claudication. In diabetic neuropathy, pain may be reduced

or absent. The skin around is dry, shiny, thin, atrophic, hairless with thick and sclerotic nails. Venous ulcers<sup>4,5</sup> are characterized by thickened margins and have usually an ellipsoidal shape. They are usually located on the medial face of the middle third of lower leg, just above the internal malleolus. The color of the skin around the lesion is dark due to ferric oxidized pigment, and often shows presence of edema<sup>6</sup>, fovea and hyperthermia. The arterial pulses are usually present.

The most frequent causes of venous leg ulcers are chronic venous insufficiency, venous hypertension or persistent impairment of microcirculation<sup>5</sup>.

There are also autoimmune ulcers, caused by the presence of circulating immune complexes that can be found at the level of endothelium of blood vessels resulting in an impairment of the local microcirculation and consequently altering the trophism of the skin<sup>1</sup>. They occur more frequently in patients with rheumatoid arthritis<sup>7</sup>. We have also to consider post-traumatic ulcers<sup>8</sup>, where there is discontinuity of the skin that often exposes the dermis and the subcutaneous fat.

They are caused by trauma and can turn into chronic ulcers, due to unfavorable conditions, such as the need for numerous surgeries, infections or inadequate treatments.

Ulcers do not tend to heal spontaneously and may become chronic if the generating causes are not removed. We speak about chronic ulcer if it lasts more than 60 days. Lipostructure has been performed to treat many disease<sup>9-14</sup>.

Thanks to the presence of angiogenic factors and mesenchymal cells in the stromal-vascular fraction<sup>15</sup> isolated from autologous adipose tissue, excellent results have emerged from the application of lipostructure in the treatment of scars and radiodermatitis<sup>16-20</sup>.

These assumptions led us to test the potential of this technique in the treatment of ulcerated areas.

## MATERIALS AND METHODS

From September 2009 to November 2011 13 patients (11 suffering from post-traumatic ulcers and 2 patients suffering from vascular ulcers) were treated with autologous fat graft. All patients underwent only one intervention under continuous intravenous fentanyl infusion associated with local anesthesia. After tumescent infiltration of 100 ml of saline solution, 75 mg of levobupivacaine, 40 mg of mepivacaine, and 0.5 ml of epinephrine 1:1000, liposuction of the subumbilical area by means of a 10-ml syringe was performed. An adipose tissue sample of approximately 10 cc was obtained and processed following Coleman's technique (i.e., centrifuged at 3000 rpm for 3 minutes). A volume of 5 to 7 cc, depending on the size of the area to be treated, was injected using an 18-gauge angiographic needle with a snap-on wing (*Cordis, a Johnson & Johnson Company, Roden, The Netherlands*) into the central portion and around the ulcer at the level of the dermo-epidermal junction. Follow-up was performed at 2 weeks, 3 months and 6 months postoperatively.

## RESULTS

In all the patients treated obvious signs of clinical improvement with a clear reduction of the ulcerated area appeared. In 9 patients, we had a complete wound healing (Figures 1, 2). The remaining 4 patients were subjected to further surgical procedures (skin graft). Concerning these patients, we had complete resolution of the ulcer. Only one patient, affected by a vascular ulcer, showed only a partial resolution of the lesion. At 6 months in 12 patients ulcers were completely healed. Only the patient affected by vascular ulcer did not present complete wound healing. We have never had any complication, neither minor nor major.

## DISCUSSION

The adipose tissue promotes the healing process by repairing and replacing the lost tissue<sup>16, 17, 20</sup>. These findings suggest that this treatment can significantly improve the functional features of patients with ulcerative diseases if compared to standard medica-



Figure 1

**Figure 1**  
Preoperative view. The patient is a 61 years woman suffering from post-traumatic ulcer.



Figure 2

**Figure 2**  
Postoperative view. 5 weeks after the surgical procedure.

tions and surgery. Lipostructure is a safe, rapid and effective procedure.

This technique is becoming very popular and the applications are increasing. Particularly, lipostructure of patients with burn scars showed encouraging results concerning texture, softness and thickness of the skin<sup>17</sup>.

Coleman's technique ensures minimal trauma to the adipose tissue. In addition, the centrifugation may allow to increase the concentration

of fat cells if compared to the simple sedimentation proposed by other authors. Patients are discharged the same day of surgery, they can then quickly return to their normal activities.

## CONCLUSION

In conclusion, ulcers are a serious problem for patients causing a marked deteriora-

tion in their quality of life. The resolution of vascular ulcers is highly dependent on the patient's general medical conditions.

Nevertheless, we think that the treatment of post-traumatic and chronic ulcers by fat grafting is yielding encouraging results and could become suitable in many types of ulcers (post-traumatic, vascular, pressure ulcers), as an additional or alternative procedure with low morbidity.

### Conflict of interest:

All Authors disclose any commercial associations or other arrangements that may pose a conflict of interest in connection with the article.

## REFERENCES

1. Diegelmann RF, Evans MC. Wound healing: an overview of acute, fibrotic and delayed healing. *Frontiers in Bioscience* 2004; 9:283.
2. Hamer C, et al. Patient's perceptions of chronic leg ulceration. In: Harding KG (eds) 2<sup>nd</sup> European Conference on advances in Wound Management. Harrogate. Macmillan M. London 1993; 178.
3. Persoon A, Heinen MM, van Achterberg T, et al. Leg ulcers: a review of their impact on daily life. *J Clin Nurs* 2004; 13:341.
4. Phillips TJ, Machado F, Trout R, et al. Prognostic indicators in venous ulcers. *J Am Acad Dermatol* 2000; 43:627.
5. Bjellerup M. Determining venous incompetence: a report from a specialised leg ulcer clinic. *J Wound Care* 2006; 15:429.
6. Veraart JC, Neumann HA. Effects of medical elastic compression stockings on interface pressure and edema prevention. *Dermatol Surg*. 1996; 22:867.
7. Lowenthal RM, Francis H, Gill DS. Twenty-year remission of rheumatoid arthritis in 2 patients after allogeneic bone marrow transplant. *J Rheumatol* 2006; 33:812.
8. Klinger M, Caviggioli F, Vinci V, et al. Treatment of chronic post-traumatic ulcers using autologous fat graft. *Plat. Reconstr. Surg* 2010; 126:154.
9. Coleman SR. Structural fat grafts: the ideal filler? *Clin Plast Surg* 2011; 28:111.
10. Coleman SR. Hand rejuvenation with structural fat grafting. *Plast Reconstr Surg* 2002; 110:1731.
11. Coleman SR. Réinjection de graisse autologue ou lipofilling ou Lipostructure®, *Ann Chir Plast Esthet* 2004; 49:456.
12. Coleman SR. Long-term survival of fat transplants: controlled demonstrations. *Aesthetic Plast Surg* 1995; 19:421.
13. Coleman SR. Structural fat grafting: more than a permanent filler. *Plast Reconstr Surg* 2006; 118:108.
14. Rigotti G, Marchi A, Galiè M, et al. Clinical treatment of radiotherapy tissue damage by lipoaspirate transplant: a healing process mediated by adipose-derived adult stem cells. *Plast Reconstr Surg* 2007; 119:1409.
15. Mizuno H. Versatility of adipose tissue as a source of stem cells. *J Nippon Med Sch* 2003; 70:428.
16. Klinger M, Marazzi M, Vigo D, et al. Fat injection in severe burn outcomes: A new perspective of scar remodeling and reduction. *Aesthetic Plast Surg* 2008; 32:465.
17. Klinger M, Caviggioli F, Klinger F, et al. Scar remodeling following burn injuries. In: Coleman SR, Mazzola RF, eds. *Fat Injection: From Filling to Regeneration*. St. Louis: Quality Medical Publishing; 2009.
18. Klinger M, Caviggioli F, Forcellini D, et al. Scars: A review of emerging and currently available therapies. *Plast Reconstr Surg* 2009; 124:330.
19. Villani F, Caviggioli F, Giannasi S, et al. Current applications and safety of autologous fat grafts: A report of the ASPS Fat Graft Task Force. *Plast Reconstr Surg* 2010; 125:758.
20. Caviggioli F, Klinger F, Villani F, et al. Correction of cicatricial ectropion by autologous fat graft. *Aesthetic Plast Surg* 2008; 32:555.