The Epidermal-adipose Graft and its Applications

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ABSTRACT

The need of reconstructing certain areas of the human body, aiming at the patient's curing above all circumstances and avoiding functional complications and major disturbances of aesthetical character, has been a constant stimulation for the research of new methods.

In face of such a situation, the authors were not satisfied with the over of the long term results of the traditional partial and/or full skin grafting and the flaps for covering lesions of certain kinds. Thus, they decided to start using the epidermal-adipose graft (EDG) in accordance with the adequate indications.

In this work, the authors display the technical approach and its clinical applications (12 patients), presenting positive details in the discussion.

Aiming at corroborating their work purpose, they develop similar studies in Wistar type rats, with a standardized macroscopic and microscopic methodology.

They also performed an objective review of the literature and emphasized the physical properties of the skin

and the grafts integration.

Their conclusion points to the fact that the composite EDG offers a significant contribution, in the form of an additional alternative, to the covering of certain tegumental lesions. It presents advantages as compared to other techniques, like easy performance, single surgical time, no deformities and minimal stigma, always making evident the fact that Reconstructive Plastic Surgery and Aesthetics complement each other.

INTRODUCTION

The need of reconstructing certain areas of the human body, aiming at the patient's curing above all circumstances and avoiding functional complications and major disturbances of aesthetical character, has been a constant stimulation for the research of new methods.

Comparing the indications of the flaps and of the traditional partial or full skin grafts and the utilization for certain kinds of lesion and their evolution over the long term, we were not satisfied with the results.

Thus, in accordance with the adequate indications, we started to use the epidermal-adipose graft; and this work purpose is to present the technique we have employed and its clinical applications.

We have developed studies in Wistar type rats, with a standardized methodology, to corroborate our work purpose.

The evaluation of the clinical applications, associated to the studies in laboratory animals, has led us to positive details on what concerns to the discussion.

Thus, the tissue reconstruction and the lesions handling receives an additional contribution with this kind of composite graft.

LITERATURE REVIEW

- The skin grafting history, in general, corroborates the fact that this technique has been applied since a long time ago, making possible, after sucessive evolutions, the utilization of the epidermal-adipose graft (EDG) in the characteristic procedures of nowadays and with knowledge of macroscopic and microscopic details.
- In 1817 Astley Cooper performed a grafting in an amputed thumb to cover the stump, determining the first human skin successful grafting. In 1823, Bünger applied on a patient's nose a skin graft from the thigh. In 1840, Warren performed a full thickness skin graft on a patient's nasal ala.
- In 1872, Ollier described the clinical applications and technical evolutions of the dermal-epidermic grafts and, in 1874, Thiersch emphasized the use of the dermal component, recommending the partial thickness grafts with a minimal amount of dermis[8].
- The full thickness grafts became well known with the applications performed by Pollock and Lawson in 1870 and LeFort in 1872 for the palpebral ectropion; in 1893, Krause perfected the technique[8].
- World War I determined two distinct phases for the skin grafts evolution: the pre and the post-war phases.
- In order to have a better understanding of the EDG behaviour, we must examine the evolution of the dermal and adipose graftings.
- Rehn reported the use of dermal grafts as early as in 1914. In 1929, Loewe presented more than a hundred cases with several different applications[1]. In 1932, Straatsma utilized a dermal graft to correct a saddle nose[19].
- On what concerns to the free (in block) adipose graft transplantation, Neuber was the pioneer who applied it in 1893. In 1910, Lexer reports a successful application of this technique to correct the contour of an hemifacial atrophy[1].
- According to Peer[12,13], there are two theories which explain the evolution of the adipose grafting (in block). The first is the *adipose cell replacement* by histiocytic phagocytosis, producing new adipose cells; the second is relative to the *adipose cell survival* by means of a

revascularization of this tissue from the fourth day on – and it is the most acceptable one.

- In 1983, Bright, Thacker and Brunner demonstrated this kind of revascularization of the adipose tissue graft by the reanastomosis of blood vessel canaliculi from the receptor bed to the adipose tissue (*inosculation*)[1].
- The dermal-adipose graft has been used since the nineteenth century to correct post-orbit-enucleation defects, which has been corroborated in 1983 by Smith[17] among others[10,20].
- The feasibility of this kind of graft in facial depressions reconstructions was reported by Peer in 1977 and, in 1969, Sawhney and colleagues demonstrated the dermal-adipose transplantations behaviour[15].
- Recent reports (1992) show the use of composite grafts in the surgical treatment of syndactylias[18].

STUDY IN WISTAR TYPE RATS
ESTUDO EM RATOS TIPO WISTAR

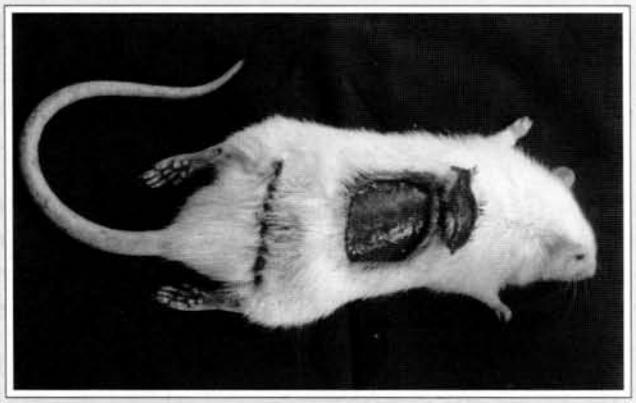

Fig. 1 – Skin and carneous panniculus composite graft removed from the posterior area (already sutured), which will be fixed to the created receiving area.

Fig. 1 - Enxerto composto de pele e panículo carnoso retirado da região posterior (já suturada), o qual será fixado à região receptora criada.

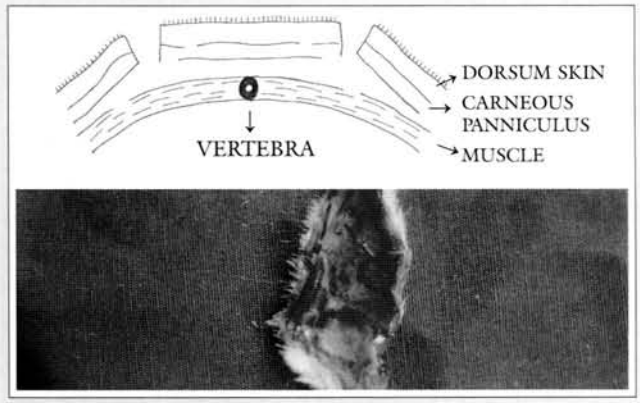

Fig. 2 – Close view of the graft (skin and carneous panniculus, simulating the epidermal-adipose graft), and schematic drawing of the rat's dorsum.

Fig. 2 - Close do enxerto (pele e panículo carnoso: simulando o enxerto epidermogorduroso), e desenho esquemático do dorso do rato.

Fig. 3 – Dressing of Brown with firm fastenings.

Fig. 3 - Curativo de Brown com amarrias firmes.

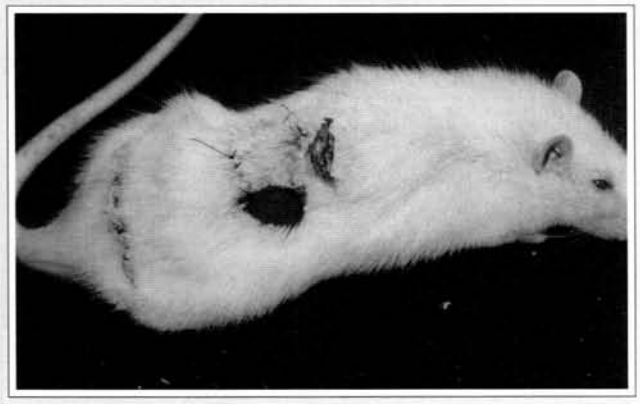

Fig. 4 – Macroscopic view of the graft integration on day 10 and the fragment for histological study.

Fig. 4 - Aspecto macroscópico da integração do enxerto com 10 dias e o fragmento para estudo histológico.

MATERIAL AND METHODS

Studies in 15 Wistar type rats were performed, employing the composite skin graft and carneous panniculus (Fig. 1, 2); both the donor site and receptor area were the dorsum (Fig. 1), with the purpose of assimilating the epidermal-adipose graft; next, dressings of Brown were made (Fig. 3).

The evaluation purpose was the graft integration, which was performed by means of a standardized macroscopic (photographs) (Fig. 4) and microscopic (histology) (Figs. 5, 6, 7) methodology.

Initially three rats were evaluated on day 5 (Group I) and afterwards along with the remaining 12 rats (Group II) on days 10, 15, 20 and 30 of post-grafting.

In all cases the graft integration has occurred.

In those rats from which the dressing of Brown was removed on day 10 (Group II) (Fig. 4), the integration was greater as compared with those rats from which the dressing was removed on day 5 (Group I); in one case of this group, a superficial desquamation of the hairs occurred, similarly to the human skin epidermolysis which happens in certain grafting cases.

The fragments removed for histological study were formed partially by the graft and partially by the cutaneous tissue of the receptor area (Fig. 4), with the purpose of studying the integration between the sutured rims and between the graft and the bed. The

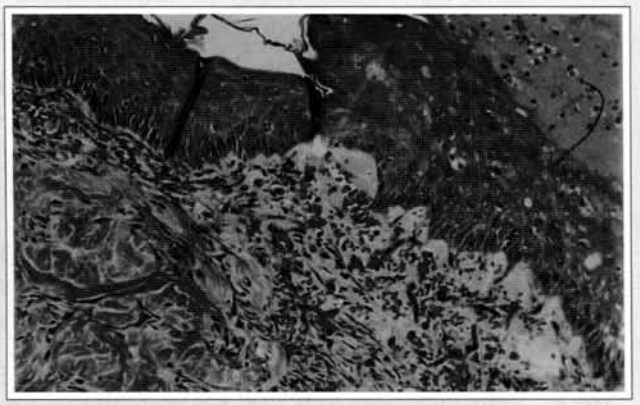

Fig. 5a – Area comprised between the suture rims with fibroblasts proliferation, vascular neoformation and infiltrate of polymorphonuclears (HE-10x10) – day 5.

Fig. 5a - Área entre as bordas da sutura ocupadas por proliferação de fibroblastos, neoformação vascular, e infiltrado de polimorfonucleares (HE 10 x 10) - 5º dia.

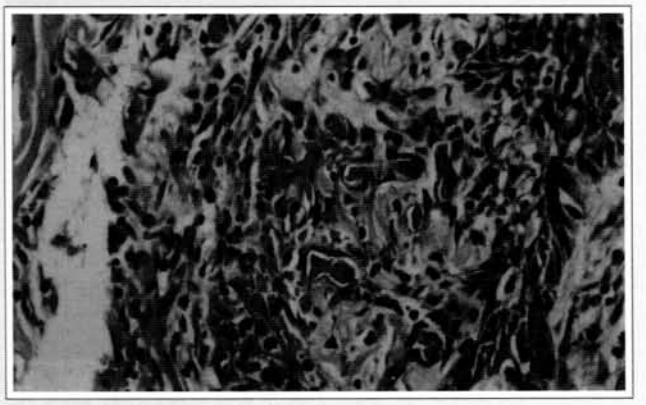

Fig. 5b – Close view of the anterior area showing the vascular proliferation.

Fig. 5b - Close da área anterior mostrando a proliferação vascular.

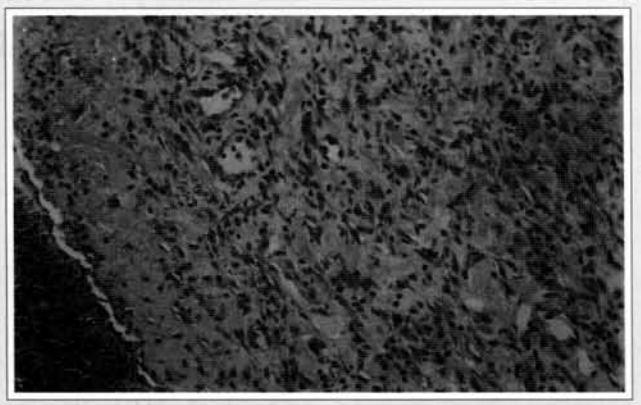

Fig. 6 – Granulation tissue, fibrin and vascular neoformation (HE-10x10) – day 10 (see text).

Fig. 6 - Tecido de granulação, fibrina e neoformação vascular (HE - 10 x 10) - 10º dia (vide texto).

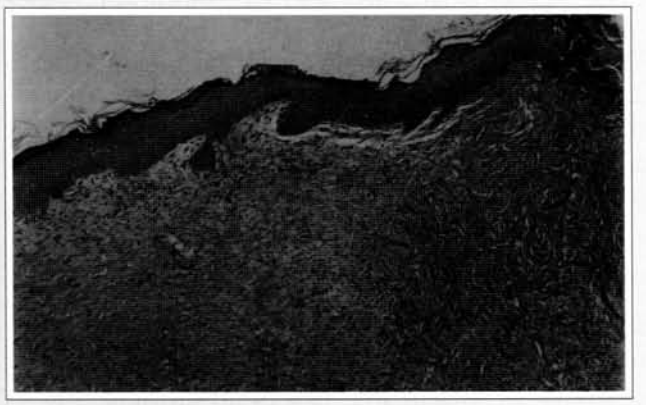

Fig. 7 – Epidermis with an area of retracting scar and organizing granulation (HE-4x10) – day 20.

Fig. 7 - Epiderme com área de cicatriz em vias de retração e granulação em fase de organização (HE - 4 x 10) - 20 dias.

material samples were fixed in tamponated formol at 10%, included in paraffin and stained by hematoxylin-eosin (HE).

Initially (day 5), the histology revealed a residue of fibrin permeated by fibroplastic proliferation with capillary neoformation, abundant infiltrate of plasmacytes, histiocytes and granulocytes, as well as hemorrhagic infiltrate, slack and edemaciate conjunctive (Fig. 5). In one of the cases the formation of microabscesses occurred. On day 10 a less intense inflamatory reaction was confirmed with granulation tissue (fibroblasts proliferation) and vascular neoformation (Fig. 6), as well as a granulomatous reaction of the foreign body type, probably due to the accidental presence of hairs of the rat. On day 20 there was the presence of granulation tissue in organization phase and retracting scar (Fig. 7).

The histological conclusion points to the fact that there was a reaction of the laboratory animals with an *integration* both on the sutured rims and in depth, corroborating the macroscopic aspect.

Initially, the clinical application was performed in 12 patients, using the epidermal-adipose graft for areas on the forehead, temple, nose, scalp, hand dorsum and thorax.

The technique determined integration and quite satisfactory results in 12 documented cases (Figs. 8, 10, 11, 12). In one of the cases a partial loss of the graft occured, but we impute it to a fault in the method chronology and performance, not to a lack of integration.

Before describing the technique, however, we think necessary to perform an objective review of this important organ of the human body: **the skin**.

The skin is formed by two distinct layers – the epidermis and the dermis. The epidermis is formed by a corneous stratum (more superficial) and a malpighian stratum, which is deeper and divided, from the deepest to the more superficial plane, in: basal or germinative layer, spinous layer, granulous layer, lucid layer or stratum; the latter occurs on the hands palms and feet soles, and the corneous stratum and the basal or germinative layer occurs on the skin of the whole body. The dermis is formed by a papillary layer (more superficial, with ondulating collagenous fibers) and a reticular layer (deeper, with dense collagenous tissue)[9,14].

Fig. 8a – Patient presenting a basocellular carcinoma on the nasal dorsum (and versant).

Fig. 8a - Paciente com carcinoma basocelular de dorso nasal (e vertente).

Fig. 8b – Resection including the aesthetical unity of the nose and leaving a "defect" with significant depth.

Fig. 8b - Resseção abordando a unidade estética do nariz deixando um "defeito" com profundidade significativa.

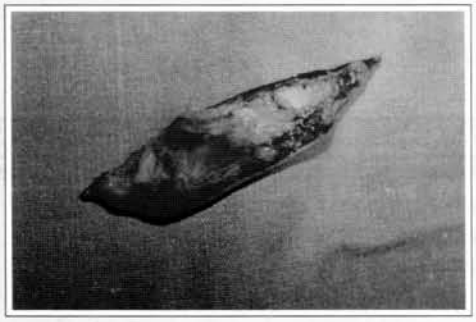

Fig. 8c – Epidermal-adipose graft (EDG) collected from the infraclavicular area.

Fig. 8c - Enxerto epidermogorduroso (EDG) doado da região infraclavicular.

Fig. 8d – Graft fixed in a slightly "stretched" form (nasal versant with primary closure).

Fig. 8d - Enxerto fixado ligeiramente "esticado" (vertente nasal com fechamento primário).

Fig. 8e – Patient's view – 2 months post-operative.

Fig. 8e - Paciente com 02 meses de pós-operatório.

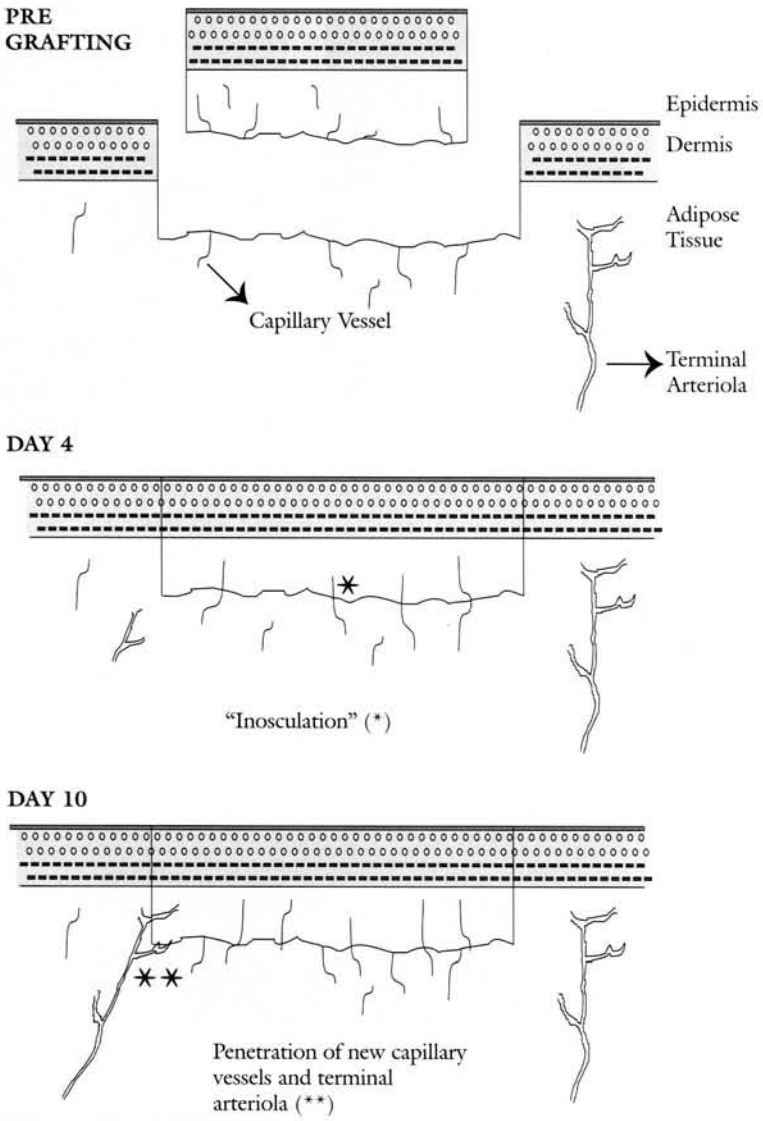

Fig. 9 – EDG graft integration phases.
Fig. 9 - Fases de integração do enxerto EDG.

To understand the possible variations of the skin, we must evince its physical properties: tension, elasticity, viscoelasticity and variation in the direction of the force lines described by Karl Langer. The skin tension is its resistance to the stretching caused by feeble forces; this resistance is greater in young people. The elasticity is the skin capacity of returning to its original shape after having been deformed by an external force; this capacity is also greater in youngsters. Both tension and elasticity are associated with collagen and elastine. The viscoelastic property, on its turn, is divided in *creep* (capacity of the skin to go on stretching when a *present and constant force* is exerted on it; the creep is clinically important on what concerns to the rotation of small flaps and wounds which do not heal) and *stress relaxation* (when the skin is stretched as far as a determined and constant distance, the force applied to stretch it is gradually reduced)[3,16].

Another factor to be considered is the integration of partial or full skin grafts. There are three phases; the first occurs within the first 48 hours and the graft is nourished by plasmatic imbibition. The second one occurs between the first 48 hours and day 5; it is the revascularization with formation of vascular sprouts from the bed to the graft. The third phase, occurring from day 5 on, is the vascular neoformation on the graft[9].

That is the reason why, in this kind of graft, we remove the dressing of Brown on day 5; nutrition by microcanaliculi occurs and integration is stablished.

As to the epidermal-adipose graft, we remove the dressing of Brown only on day 10 or later, as long as there are no signs of evident secretion – a topic which will be further discussed later on.

On what concerns to contraction, we know that partial thickness grafts present a smaller primary contraction and greater secondary contraction. The full thickness grafts, on their turn, present a greater primary contraction (greater elastic amount in the dermis) and smaller secondary contraction. Such an evaluation is essentially important so that we can understand the over the long term results of the patients, which may present a good immediate post-operative evolution and develop retractions on the late post-operative period (especially those with partial thickness grafts)[9,14].

Thus, as in the epidermal-adipose graft we include the whole dermis, secondary contraction is almost non-existent.

TECHNICAL APPROACH

As soon as the favorable status of the receiving bed has been stablished, and keeping in mind the contraindications for the grafting of a given area (on the bone without the periosteum, cartilage without the perichondrium, on vessels, poorly vascularized tis-

Fig. 10a – Patient presenting basocellular carcinoma of the cicatricial plane type and ulcerated.

Fig. 10a - Paciente com carcinoma basocelular tipo plano cicatricial e ulcerado.

Fig. 10b – Area of the defect created after resection.

Fig. 10b - Área do defeito criado pós-operatório.

Fig. 10c – 12 days post-operative (when the dressing of Brown was removed).

Fig. 10c - Pós-operatório com 12 dias (quando foi retirado o curativo de Brown).

Fig. 10d – Four months post-operative.

Fig. 10d - Pós-operatório de 04 meses.

sues, etc.), we utilize a mold which will be transferred to the donor site. The donor site may be the supra or infraclavicular area (used in the majority of cases), the inguinal area, the thigh root and the retroauricular area, as well as the subgluteus sulcus, the elbow fold and the wrist fold.

The epidermal-adipose thickness roughly corresponds to the depth of the defect to be covered; in our casuistry, it ranges from 2 to 6 mm. The graft to be fixed does not present exactly the same dimensions (width and length) as the receptor area; it is slightly smaller, so that after being sutured it becomes a little *stretched* (*see* skin physical properties, previously described) (Fig. 8d).

The dressing of Brown is applied in all cases, with the use of vaselinated uncture on the graft, humidified cotton waddings or balls and gauze with firm fastenings.

It will be on for 10 days. If we observe in the dressing the presence of evident secretion and infection signs it should be removed before completing its ideal stated period, and regarding the wound all necessary care has to be given to it.

As to the case which presented partial loss in our casuistry, the dressing was removed on day 5 and the graft dimensions did not correspond to those recommended.

DISCUSSION

The epidermal-adipose graft (EDG) presents advantages as compared to the traditional skin graft, and even on what concerns to certain flap indications.

The partial skin grafts are known to present a safe indication for covering extensive areas and even poorly vascularized areas; however, when it is indicated for certain *defects*, they present some disadvantages: they may cause depressions, enhanced contraction, abnormal pigmentation, lack of growth in children and may even suffer reabsorption[14].

The flaps accurate indications are also well known, but in the cases for which we may choose between the flap and the EDG graft, we opt for the latter. The flaps late results often present edema and incurvements, requiring prolonged massages and other refinements, cause visible scars on the donor site (mainly in young people) and some of them require a second surgical time.

As to the EDG graft, contraction is insignificant; it presents texture and pigmentation quite similar to the normal skin, has a visible mobility on the previous bed and with the neighbouring units and does not present depression (these factors may not occur with the traditional full skin graft)[4]. In addition, the EDG determines an easily performable technical approach

Fig. 11a – Nasal tumor (basocellular carcinoma) with growth of the "iceberg" type.

Fig. 11a - Tumor nasal (carcinoma basocelular) com crescimento tipo "iceberg".

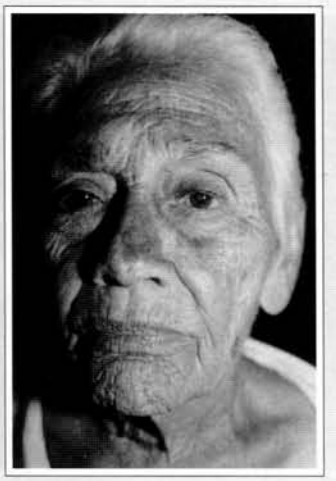

Fig. 11b – Six months post-operative.

Fig. 11b - Pós-operatório 06 meses.

Fig. 11c – Profile view – six months post-operative.

Fig. 11c - Perfil de 06 meses.

Fig. 12a – After resection of a nasal tumor in accordance with the aesthetical unity, a EDG graft from the infraclavicular area was performed – 10 days post-operative.

Fig. 12a - Após resseção de tumor nasal obedecendo a unidade estética, foi feito enxerto EDG da região infraclavicular - 10º pós-operatório.

Fig. 12b – Five months post-operative.

Fig. 12b - Pós-operatório de 05 meses.

Fig. 12c – Profile view – five months post-operative.

Fig. 12c - Perfil com 05 meses.

and requires a single surgical time.

The inconvenient presence of hairs in certain grafts to be fixed on areas which are normally hairless may be solved by electrocoagulation of the pilose follicles at the pre-grafting phase.

The complications and factors which cause lack of integration of the EDG grafts are: inadequate bed, hematoma, sliding of the graft on the bed on the first post-operative days, infection and technical fault, both on the confection of the grafting process and the permanence time of the dressing of Brown.

The EDG graft integration process is analog to the adipose tissue graft integration recommended by Bright and colleagues[1] as well as by Peer[1,12]. Approximately on the fourth post-operative day, the anastomosis between capillary canaliculi – 10 to 12μ (vascular conductors) of the receptor bed with those of the graft present in its adipose portion occurs; this anastomosis is also known as *inosculation* (hitherto the nutrition occurred by plasmatic imbibition). Approximately on the tenth post-operative day the penetration of new capillary vessels and then of terminal arteriolae occurs – 10 to 30μ from the bed to the graft **(fig. 9)**.

In circumstances like these, the dressing of Brown is never removed before the tenth post-operative day, preventing the graft sliding and assuring the formation of new capillary vessels which will provide a longer duration to it.

In cronic smoker patients, the initial microcirculation of the cutaneous graft integration may be impaired[2].

In those patients who perchance present alterations as to the graft pigmentation, corticoid based creams may be used.

CONCLUSION

Cutaneous reconstruction may be performed in several ways, from methods in which the body itself commands the events – like healings by second intention – to techniques of traditional flap grafting, among others. The plastic surgeon must always keep in mind the need to cure the patient, but with the minimal amount of functional and aesthetical alterations.

Thus, we judge that the plastic surgeon must not concentrate on perfection but, whenever possible, on the structural harmony of the human body.

In accordance with such purposes, we conclude that the epidermal-adipose graft offers a significant contribution, in the form of an additional alternative, to the covering of certain tegumental lesions. It presents advantages as compared to other techniques, like easy performance, single surgical time, no deformities and minimal stigma, always making evident the fact that Reconstructive Plastic Surgery and Aesthetics complement each other.

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