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GRAFTS AND FLAPS PANORAMIC REVIEW

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SUMMARY

Introduction: *Skin grafts over time have progressed to present multiple well-established reconstructive techniques that are remarkably capable of restoring structure, function, and aesthetics to a myriad of surgical wounds. Muscle and myocutaneous flaps are common reconstructive alternatives for individuals with acquired oncologic or traumatic defects. Knowledge of flap anatomy and surgical techniques is paramount for surgeons who practice them to achieve the best results.*

Objective: *to detail current information related to grafts and flaps; definition, description, classification, characteristics, indications and techniques.*

Methodology: *a total of 33 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 20 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: flaps, grafts, skin, wounds, surgical reconstruction, skin transfers.*

Results: *skin grafting is a basic technique and a widely used reconstruction option in surgery, following tumor resection, ulcers, as well as in burned individuals. Graft retraction is inversely proportional to graft thickness. The graft should globally correspond to the loss of substance to be covered. When planning myocutaneous flaps, knowing the vascular territories of each source artery, or angiosome, allows proper design of the skin island. Unlike fasciocutaneous flaps, muscle and myocutaneous flaps tolerate ischemia poorly, and any concerns about flap ischemia necessitate a timely return to the operating room for exploration.*

Conclusions: *Recognizing when, where and how to perform a graft or flap is of vital importance for the correct management of the affected individual. The surgical fundamentals and associated factors must be well known to achieve the best performance and*

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achieve the best results in patients. Both grafts and flaps have their indications that must be adapted to the patient in question. It is necessary to emphasize that it is necessary to differentiate perfectly between the graft and the flap, analyzing their peculiarities, different uses and possible complications. Grafts are devoid of any vascular connection, while flaps depend on the vascularization of the recipient wound bed to survive.

KEY WORDS: *flaps, grafts, skin, wounds, reconstruction, transfers, surgery.*

INTRODUCTION

Skin grafts have progressed over time to present multiple well-established reconstructive techniques that are remarkably capable of restoring structure, function, and aesthetics to a wide range of surgical wounds. A skin graft is a transfer of free skin tissue that is detached from a donor site and transplanted to a recipient site and is chosen when second intention healing, primary closure or flap repair is considered inadequate. Full-thickness skin grafts (FTSG) consist of the entire epidermis and dermis, while partial-thickness skin grafts (PTSG) consist of the entire epidermis and only part of the dermis. Full-thickness skin grafts are relatively simple to obtain and secure at the recipient site. Suitable donor skin should largely match the color, thickness, level of actinic damage, and texture of the skin surrounding the defect(1-3).

Muscle and myocutaneous flaps are common reconstructive alternatives for individuals with acquired oncologic or traumatic defects. Although fasciocutaneous and perforator flaps have emerged as elegant reconstructive alternatives for multiple indications, muscle and myocutaneous flaps remain widely useful flaps in large or infected wounds. Knowledge of flap anatomy and surgical techniques is paramount for surgeons who practice them to achieve the best results(4).

METHODOLOGY

A total of 33 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 20 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: flaps, grafts, skin, wounds, surgical reconstruction, skin transfers.

The choice of bibliography exposes elements related to grafts and flaps; definition, description, classification, characteristics, indications and techniques are presented.

DEVELOPMENT

Grafts

The skin graft is a piece of skin of variable thickness devoid of any vascular connection, separated from its donor site and subsequently transposed on the recipient site that forms the loss of substance that is intended to restore. Usually, autografts are used, in other words a graft mobilized from the same affected individual. Skin grafting is a basic technique and a reconstructive alternative frequently used in reconstructive surgery, after tumor resection, as well as in case of ulcers or in patients with burns(2,5).

Classification of Skin Grafts

A. By thickness

1. skin grafts of variable thickness: made up of epidermis and variable thickness of dermis:
   a) Ollier-Thiersch thin, consisting of epidermis, basement membrane and dermal papillae (0.15-0.25 mm).
   b) Intermediate or semi-thick Blair-Brown of 0.3-0.4 mm.
   c) Thick graft including 75% of the skin (0.5-0.6 mm).

2. Total skin grafts: made up of the epidermis and dermis with the epithelial attachments in their entirety. The attachment is more difficult. Widely used in hand surgery.
   a) Total skin grafts of 0.8-1.5 mm (Wolfe-Krause). Traditionally, adipose tissue lobules must be removed.
   b) Supertotal" grafts, some lobules of adipose tissue and the subdermal anastomotic network are included.

Variants of Total Skin Grafts

Pill grafts or Davis grafts: indicated for chronic leg ulcers, not recommended for use on the face. The mobilization technique consists of raising a small cone of skin with a Reverdin needle, sectioning at its base, obtaining a graft of variable thickness whose center is of full thickness. Subsequently, place the grafts in the recipient area in continuity without suturing, it should be covered with a fatty dressing.

Total skin embedded punch grafts: the graft is mobilized with a punch used for biopsies, then the lobules of adipose tissue are removed. The recipient bed is punctured with the punch to access a better vascularized bed. Lastly, each graft is then engaged in the holes created. This technique is curious and simple, because it does not require specific equipment such as a dermatome.

Composite Grafts

Composed of 2 different tissue structures, usually skin and cartilage. The chondrocutaneous graft is used in the reconstruction of penetrating substance loss of the nasal free edge. It is recommended that the graft should not exceed 1.5 cm for viability reasons. The donor site is usually the anterior root of the antihelix. It presents a high risk of necrosis(2,5).

B. By the moment at which the graft is performed:

Immediate graft: performed immediately after the tumor resection, to repair the loss of substance in a short time.

Delayed graft: performed at a second surgical time to obtain pathological certainty of the radical nature of the tumor resection and confirmation of healthy margins. It is justified in aggressive tumors and tumor recurrences, sometimes to obtain granulation tissue when there is an extensive resection in depth

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and/or width and rarely when adequate hemostasis of the recipient site is not possible(6).

C. By the mode of use:
Continuous Graft: covers the entire loss of substance with a single piece or multiple pieces sutured together.

Discontinuous Graft: which does not cover the entire loss of substance such as the Tanner and Vandeput meshed graft and the plurifragmentary graft(7).

Figure1. Skin condition on the right hand that would benefit from grafting.

Source: The Authors.

Biology of Graft Attachment
By definition, the graft does not present its own vascularization, so the attachment depends on the vascularization of the recipient area, as well as on the revascularization capacities of the graft. Therefore, the graft can only take hold in a dermis of good vitality or in tissues capable of generating granulation tissue such as subcutaneous tissue, muscle, periosteum, perichondrium. The donor site must not be infected or too exudative, and the granulation tissue must not be excessive.

Blood Revascularization: it is preceded by an ischemic stage during which the graft presents few exchanges with the recipient bed. The duration of the stage depends on the quality of the recipient bed. The risk of partial or total failure depends on the duration of this stage. The tolerability of this ischemic stage increases with the thickness of the graft.

In the first hours the graft adheres by means of a fibrin network exuded by the recipient bed, then the graft survives by plasma imbibition, usually until the fourth day, then it appears edematous presenting a plasma exudate accompanied by blood cells, giving a pink color, then vascular penetration is maintained until the eighth day. The revascularization of the graft can take place due to the colonization of the vessels sectioned by the vascular buds, with the creation of anastomoses, originating the primary revascularization of the graft, requiring an intimate contact between the graft and the receptor bed. There is also secondary vascularization due to penetration of the graft by neovessels.

Lymphatic Circulation: it is restored at the same time as blood revascularization.

Graft Reinnervation: takes place in a few weeks, however, from the clinical point of view, sensitivity needs several months. Sensitivity returns in a better way in total skin grafts.

Graft Retraction
It is inversely proportional to the thickness of the graft, usually within a few weeks. The dermal component determines the mechanics of the graft, the functional part and the aesthetic result. Normally, the thicker the graft, the better the functional and aesthetic mechanical properties, however, the neovascularization and revascularization conditions worsen.

Factors influencing the phenomenon of graft attachment.
There are factors involved that depend on the technique such as asepsis, quality of graft mobilization, graft size, quality of the recipient bed, the effects of endothelial growth factors that improve graft viability(8).

The recipient bed has to present compatibility such as that presented in the muscle, peritendon, subcutaneous cellular tissue, aponeurosis, perichondrium and periosteum. Another recommendation would be that the graft covering dressing should not adhere to the graft, in addition it should be very fatty and should be maintained for 4-5 days. Devitalized, irradiated or excessive fibrosis tissues do not allow revascularization.

Other factors such as arterial and/or venous insufficiency in the lower limb grafts compromises their attachment, as well as microcirculation pathology, smoking, coagulation anomalies, plants that have an antiplatelet, anticoagulant or fibrinolytic effect, some phytotherapeutic drugs with hemorrhagic risk.
Regarding the use of anticoagulants, the recommendations are aimed at seeking safety against bleeding risk, without compromising the expected protection against thrombotic risk(1,9-11).

Figure 2. Electric dermatome, a surgical instrument used to produce thin sheets of skin from a donor area for use in making skin grafts.

Source: The Authors.

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Technique, Instruments and indications for Variable Thickness Skin Grafts.

To allow the movement of the graft according to the required thickness, it is necessary to use a dermatome. There are several presentations such as the manual dermatome of Lagrot modified by Dufourmentel that allows the adjustment of the thickness and the electric or pneumatic dermatome of Padgett that allows easier mobilization of the graft by adjusting the micrometric screw to the desired thickness.

Mobilization of The Graft

An assistant is needed to tense the skin placed in front of the dermatome. To improve the mobilization, a local anesthesia of tumescent anesthesia type could be used, hardening the cutaneous plane. It is recommended to place vaseline oil on the selected area to improve the progression of the dermatome.

Among the most frequently used donor sites are the anterior thigh, buttocks, abdomen, inner and outer arm and forearm.
The mesh graft technique is an amplification of a graft in order to cover larger surfaces. The graft is introduced in a cylindrical device provided with very close blades that transforms the continuous cutaneous graft into a mesh. This is then introduced through its dermal side into the device and exits through its epidermal side. Multiplying the surface by 3, it can be applied on an exudative and over-infected bed. For the graft, the dressing is similar to that of the total skin graft.

Complications

They are hematoma, seroma and superinfection. Retraction, dyschromias and scarring of the donor site worsen the aesthetic result.

Indications

Thin skin grafting is a mandatory method for repair of extensive substance loss. Retraction is noticeable, usual dyschromias, not used as a choice for facial reconstructions, unless temporary. Useful in burns in ulcer coverage and after resections of Verneuil's disease(5,12).

Total Skin Graft

Graft mobilization- donor site

It must be selected conscientiously, the graft must be well vascularized, be compatible, present a texture, thickness, color and level of photoaging similar to those of the skin to be grafted. The absence of precancerous lesions must be taken into account, as well as hairs in case of grafting hairless sites. In melanoma surgery, it is avoided to mobilize the graft from the homolateral limb to the tumor, because it can present metastasis in transit(2,5).

Grafts from the correction of a tissue excess.
Also called adjacent grafts, because they are contiguous to the loss of substance, which in most cases is partially sutured according to the lines of least cutaneous tension. Tissue proximity provides a resemblance in color and texture.

Graft placement.
The graft should fully correspond to the loss of substance to be covered. The retraction of the total skin graft is minimal. It is placed on the recipient bed without allowing it to dry. To fix the graft, stitches are given at the four corners of the graft called cardinal points. Subsequently, separate stitches or a continuous suture is performed in the periphery. When suturing, it is recommended that the needle enters first at the level of the edge of the graft, to exit through the edge of the recipient bed, placing the graft on its nourishing zone. Incisions in the center of the graft are constantly debated(1,5,13).

Figure 3. Skin graft placed on the recipient area (distal area), you can see the old flap applied in the most proximal area of the leg.

Source: The Authors.

The dressing should be oily. A tulle or an interphase is used on which the petroleum jelly is deposited, maintaining a moist medium, preventing the dressing from sticking during dressing change. It is recommended to leave the dressing in place for 2-5 days.

Advantages of Total Skin Grafting

It is a relatively safe solution, infrequently limited by the area to be grafted. If graft attachment is not generated, a new graft can be attempted. Disadvantages of total skin grafting, complications.

A well vascularized recipient bed is required, sometimes the grafting is incomplete. The aesthetic result is uncertain, additional scarring of the donor site, sometimes dyschromia, hypertrophy, partial or total necrosis, hematoma followed by superinfection(14).

The indication of a total skin graft must be individualized because it will depend on the characteristics of the tumor and the patient. The indication of a graft is proposed when resection-suture is not possible and when directed healing is not desired. The technical discussion mainly concerns flaps(5).

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Figure 4. Defect requiring a flap on the back of the right thigh.

Source: The Authors.

Flaps.

By definition, a flap is a piece of tissue with a defined blood supply, allowing it to be differentiated from a graft. Due to anatomical studies, improved technology and wartime injuries, flap reconstruction has evolved to act on difficult traumatic and oncologic defects(15).

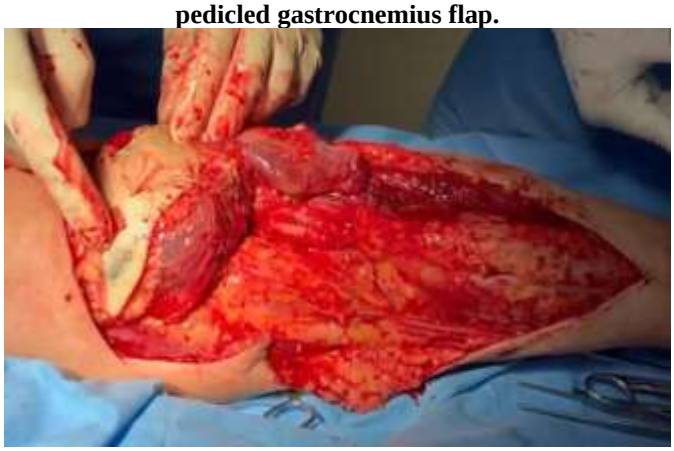
Muscular and myocutaneous flaps are divided according to the pattern of vascular irrigation. According to the classification proposed by Mathes and Nahai there are five fundamental patterns of muscular circulation:
Type I, such as the tensor fascia lata, presents a single dominant vascular pedicle.
Type II, such as the gracilis, presents a dominant pedicle and minor/segmental pedicles.
Type III, such as the rectus abdominis and gluteus maximus, has two dominant pedicles, only one of which is required to innervate the muscle.
Type IV, such as the sartorius or tibialis anterior, present a segmental blood supply without a dominant pedicle.
Type V, such as the pectoralis major or latissimus dorsi, have a dominant pedicle and secondary segmental pedicles; these can be innervated by secondary pedicles if the dominant pedicle is sacrificed.

Muscle flaps can be used locally, continuing to be attached to their blood supply through a pedicle, or used for distant reconstruction as a free tissue transfer, requiring microvascular anastomosis. Myocutaneous flaps are composite flaps with a unique vascular supply incorporating skin, subcutaneous tissue, fascia and underlying muscle. In contrast, in joint or chimeric flaps, each flap component has a distinct perforator that initiates in a source vessel; myocutaneous flaps are dissected en bloc to preserve all the perforator muscles of the overlying soft tissue, which is evident in easier dissections(4,16).

Figure 5. Removal of the anatomical position of the pedicled gastrocnemius flap.

Source: The Authors.

Figure 6. Accommodation at the recipient site of the pedicled gastrocnemius flap.



Source: The Authors.

Muscle flaps can occupy dead space and provide a vascularized surface for grafting, however a properly performed myocutaneous flap can provide volume to the recipient site and obviate the requirement for a skin graft. When planning myocutaneous flaps, understanding the vascular territories of each source artery, or angiosome, allows for proper planning of the skin island(17,18).

Once a pedicled or free tissue transfer is performed, the newly transferred flap begins to incorporate into the surrounding tissue. Assuming that the wound bed is well vascularized, vascular ingrowth will be present within four to five days, however, sufficient vascular ingrowth to irrigate a flap independent of its blood supply requires more time, even weeks.

Indications

Muscular and myocutaneous flaps are used to cover multiple oncologic or traumatic defects throughout the human body. Commonly used in head and neck reconstructions, pressure ulcers, perineal, extremity, breast. In places with a high possibility of infection and a large dead space, muscle flaps could be chosen. For limb reconstruction, weight-bearing sites benefit from a myocutaneous flap.

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Contraindications

Hemodynamic instability requiring vasopressor support represents a contraindication for free tissue transfer. In general, there are few absolute contraindications for muscle or myocutaneous flaps. Among some of the relative contraindications are: previous radiation to donor sites, history of thrombosis or hemorrhage, history of surgery that virtually compromises the vascular supply of the proposed muscle, and when sacrifice of the donor muscle would lead to unacceptable disability. Tobacco use has been associated with delayed wound healing.

Equipment and preparation.

For muscle or myocutaneous free flap surgery, microsurgical equipment and magnifying loupes or an operating microscope are required, as well as drugs, such as lidocaine or papaverine, for possible vasospasm. In situations of microvascular anastomosis, heparinized saline and intravenous thrombolytics are important, as well as the use of portable Doppler. Local or pedicled muscle flaps do not require any specialized equipment other than typical plastic surgery equipment.

Computed tomography with angiography may be prudent when the status of the vascular pedicles or recipient vessels is unclear. Contaminated wounds should be washed and debrided multiple times to reduce the bacterial load prior to flap. A multidisciplinary team evaluation by the healthcare team is important for a more successful reconstruction(4).

Figure 7. Immediate Postoperative, after Flap Placement.

Source: The Authors.

Technique and treatment

When considering a free tissue transfer, the first step is to identify the appropriate recipient vessels to nourish the muscle or myocutaneous flap. Next, dissection of the flap begins.

In muscle flaps, an incision is marked to gain access to the muscle body and associated vascular pedicle, then deepened to the muscle body with or without the overlying fascia. Subsequently, unneeded perforators are cut or cauterized and the muscle is delaminated from the surrounding soft tissue envelope.

In pedicled flaps, the muscle is skeletonized to ensure a tension-free arc of rotation or renewal; patency of the pedicle can be confirmed with Doppler. Sometimes it is not necessary to see the pedicle to have a safe transfer.

In muscle-free transfer, the vascular pedicle is isolated and trimmed, and shortly thereafter a microvascular anastomosis is quickly performed to minimize ischemic damage to the muscle. The muscle is then inserted and hemostasis of the donor site is obtained prior to closure.

In myocutaneous flaps, the desired skin island is marked and the incision can be extended to allow dissection of the flap. Designing a skin island within the known flap angiosomes will reduce ischemia of the portions of the flap farthest from the vascular pedicle. The decision to reinnervate the muscle for free tissue transfer depends on the reconstructive goal(4).

Complications

These are infection, seroma or hematoma of the donor and recipient sites, fat necrosis, partial or total loss of the flap and wound dehiscence. Specific flaps, such as the TRAM flap, can generate hernia or significant abdominal laxity, while laxity of the latissimus dorsi donor sites can create seromas. When muscle flaps begin to look gray or slightly bleeding with pinprick, they suggest ischemia. Myocutaneous flaps have the added benefit of a skin paddle that serves as a monitor of the overall condition of the flap. In contrast to fasciocutaneous flaps, muscle and myocutaneous flaps tolerate ischemia poorly. Correct positioning measures are recommended so as not to allow the vascular pedicles to be compressed(19,20).

CONCLUSIONS

Recognizing when, where and how to perform a graft or flap is of vital importance for the correct management of the affected individual. The surgical fundamentals and associated factors must be well known to achieve the best performance and achieve the best results in patients. Both grafts and flaps have their indications that must be adapted to the patient in question. It is necessary to emphasize that it is necessary to differentiate perfectly between the graft and the flap, analyzing their peculiarities, different uses and possible complications. Grafts are devoid of any vascular connection, while flaps depend on the vascularization of the recipient wound bed to survive.

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