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Full-Thickness Skin Grafts in Reconstructive Dermatologic Surgery of Nasal Defects

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1. Introduction

The nose is one of the most important facial features and any change in its shape, colour or skin cover may be very obvious. Nasal defects are a common challenge for dermatologists and plastic surgeons in daily practice. Many benign and malignant lesions are located in the nasal region. Basal cell carcinoma is the most common skin cancer and is found frequently in this anatomical region. The size of defects secondary to excision of these lesions may not allow primary closure or reconstruction using skin flaps and requires the use of skin grafts. Skin grafts are particularly suitable for large defects occupying almost entire cosmetic units, and especially in elderly patients with acceptable cosmetic results in many cases.

A precise knowledge of the anatomy of the nasal region is essential, before considering reconstructive options. Like the underlying bony-cartilaginous framework of the nose, the overlying skin may also be divided into vertical thirds. The skin of the upper third is fairly thick but tapers into a thinner mid-dorsal region. The inferior third regains the thickness of the upper third owing to the more sebaceous nature of the skin in the nasal tip. The dorsal skin is usually the thinnest of the 3 sections of the nose. The nasal muscles are deep in the skin and include four main groups: the elevators, depressants, compressor, and the dilators. The elevators are the procerus and levator muscle of upper lip and nasal ala. Depressants are composed of the nasal alar and nasal septum depressor. The muscles are interconnected by a fascia called the nasal superficial musculoaponeurotic system (SMAS).

The soft outer tissue of the nose can be divided into subunits. The purpose of the subunits is to divide the nasal anatomy into segments useful for reconstruction. If more than 50% of a subunit is lost, it may be necessary to replace the entire unit with regional tissue or tissue from a donor. The subunits include the nasal dorsal segment, lateral wall segments, the hemi-lobe soft tissue triangle segment, and alar columellar segments.

The nose, like the rest of the face, has a rich blood supply. The arterial supply to the nose can be divided principally into the internal carotid branches, ie branches of the anterior and posterior ethmoidal arteries of the ophthalmic artery and the external carotid branches,

namely the sphenopalatine, greater palatine arteries, upper lip, and angular. The external nose is supplied by the facial artery, which becomes the angular artery attending on the superomedial side of the nose. Sellar and dorsal regions of the nose are supplied by branches of internal maxillary artery (ie, the infraorbital) and ophthalmic arteries (corresponding to the internal carotid system). Internally, the lateral nasal wall is supplied by the sphenopalatine artery and posterior ethmoidal arteries. The nasal septum is also derived from the blood supply from the sphenopalatine and anterior and posterior ethmoidal arteries with additional input from the superior labial artery (above) and the greater palatine artery (posterior). The Kiesselbach plexus or Little's area, represents a region in the anterior third of the nasal septum, where all three of the main arteries converge in the inner nose.

The veins of the nose essentially follow the arterial pattern and are important for direct communication with the cavernous sinus. The vein of the cavernous sinus lacks valves, which enhances the spread of intracranial infection.

Nodes arise from the superficial mucosa and drain in retropharyngeal and upper deep cervical lymph nodes and / or submandibular glands. The sensation of the nose is derived from the first two branches of the trigeminal nerve. The parasympathetic innervation arises from the greater superficial petrosal (GSP) branch of cranial nerve VII. The GSP joins the deep petrosal nerve (sympathetic innervation), which comes from the carotid plexus to form the nerve in the canal vidian. Vidian nerve travels through the pterygopalatine ganglion (only the parasympathetic nerves synapse here) to the lacrimal gland and glands of the nose and palate by the maxillary division of trigeminal nerve.

The nose can also be divided into the superior cosmetic unit, in which skin is usually thin, elastic, loose and frequently not sebaceous, and the inferior cosmetic unit in which the skin is usually thick, less elastic, tightly attached to the underlying structures and much more sebaceous. The inferior cosmetic unit is much more complex because the cartilages of the lower unit attach to each other and to the nasal septum by fibrous aponeurotic bands. Distortion of this lower segment can lead to both cosmetic and functional defects.

2. Full-thickness skin grafts to repair nasal defects

Full-thickness skin grafts (FTSGs) contain the entire epidermis and dermis and preserve adnexal structures, so they are very useful in the reconstruction of nasal defects. Grafts offer great variability in size and shape and allow for the closure of a wide variety of defects.

Multiple donor sites are available, enabling selection of the closest tissue match. Disadvantages include the creation of a second surgical site and suboptimal tissue colour and texture match if an improper donor site is selected. Additionally, complete denervation of the graft occurs such that patients rarely experience full sensation at the recipient site even after prolonged periods. Currently skin grafting continues to be a viable, useful, and versatile closure option, and in some instances, is the best choice. FTSGs are indicated as a repair consideration for surgical defects that cannot be opposed primarily or with a flap, and where healing by second intention is likely to result in poor cosmetic or functional deficits.

The use of FTSGs enables better cosmetic and functional results and preserves the basic skin functions such as sweating, and pigment production. In addition, the increased thickness of FTSGs results in a more complete filling of deeper surgical defects and less wound contracture.

2.1 Performance of nasal full-thickness skin grafts

Tumour-free margins prior to reconstruction are the most important challenge. In the case of well-defined malignant lesions, excision should be performed with an adequate margin for curative oncological outcome (figure 1). When the lesions have vague or unclear boundaries, Mohs micrographic surgery with surgical pathology frozen sections, or delayed reconstruction after securing margins are free from tumour are good alternatives.



Fig. 1. Basal cell carcinoma excised with an adequate margin in order to achieve oncological cure. On the left, before excision and on the right after it.

When selecting the donor area, the first key point is to choose the donor skin area in such a way that it resembles as much as possible the skin of recipient area. A donor site must be selected in order to achieve direct closure with a minimally visible scar. Among the factors to consider for a successful donor site selection, include the colour of the skin, the texture of the tissue, the amount of sun damage, and the presence or absence of hair. The most frequent donor sites used for the reconstruction of nasal defects that meet the above requirements are preauricular skin and skin of the glabella (figures 2 and 3). If the patient has hair on the glabella, which is quite common in males, glabella will not be a good donor site.

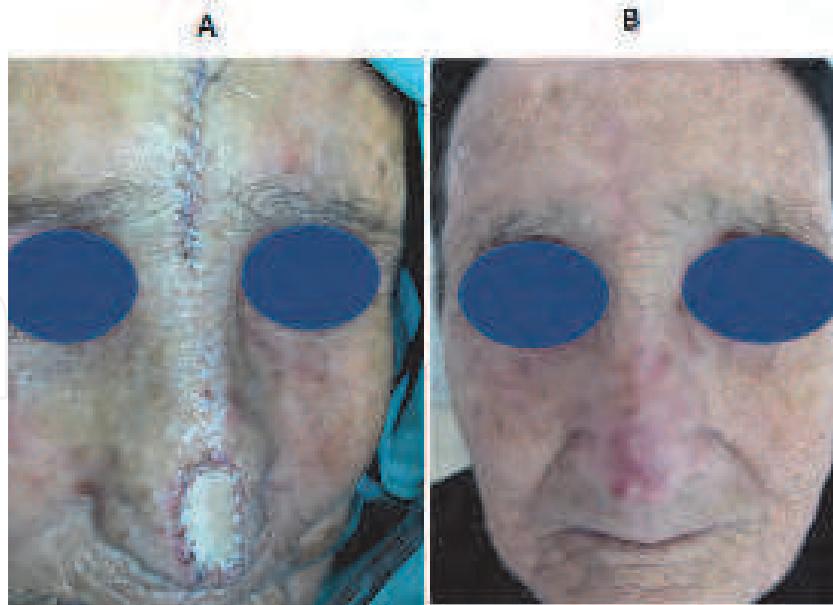


Fig. 2. Full-thickness skin graft to cover a big defect on the nasal tip. The donor site chosen was the glabella. A: In the immediately postoperative moment; B: Four month later.



Fig. 3. Full-thickness skin graft to cover a big defect on nasal tip. The donor site in this case was the preauricular skin. A: Design of the graft at the donor area; B: Immediately postoperative moment.

After selecting the donor area, the defect is measured accurately and those measures are moved and drawn with a surgical marker on the donor skin. It is recommended that the dimensions of the graft are a 10-20% larger, to avoid obtaining a final graft too small. The split graft donor site with oval morphology, although the defect may be circular, ensures sufficient tissue for grafting. However it is preferable that the graft is well stretched, once fixed, as an excess of tissue impedes adequate diffusion of nutrients. Thus once set, the redundant tissue should be trimmed

Atraumatic handling of the skin graft should not be forgotten at any time, to avoid complications due to damage to the vascular network. Management of the graft is preferred with toothed forceps, without exerting excessive pressure, taking the ends of the ellipse, and preferably only the dermis.

Once the graft is removed, it should be quickly transferred to a sterile container with saline solution. It is important to work efficiently to prepare the graft for placement as soon as possible on its recipient bed to permit that diffusion of nutrients can begin. To facilitate this, it is recommended only essential haemostasis at the donor site. Excessive haemostasis may prevent grafted skin from adequate nourishing from the receptor bed, while inadequate haemostasis can cause bleeding and development of hematoma under the graft, creating a gap between it and the bed, leading to the same problem.

Defatting of the graft is performed effectively with scissors, preferably if they have a curved tip, even though straight scissors are also appropriate (figures 4 and 5). It is important to make this process as soon as possible to avoid the lack of perfusion of the graft over time. The shorter the time that the graft is immersed in saline, without oxygen, the greater the likelihood of success. The fat globules are removed carefully by tangential cuts with scissors. All fat should be removed, until only the dermis, with its distinctive glistening white colour, is visibly (figure 6). If this process is not properly managed, there is a greater likelihood of necrosis, as any adipose tissue acts as a barrier to the diffusion of nutrients between the recipient bed and graft dermis. If the process continues it is recommended to periodically wet the graft with saline.

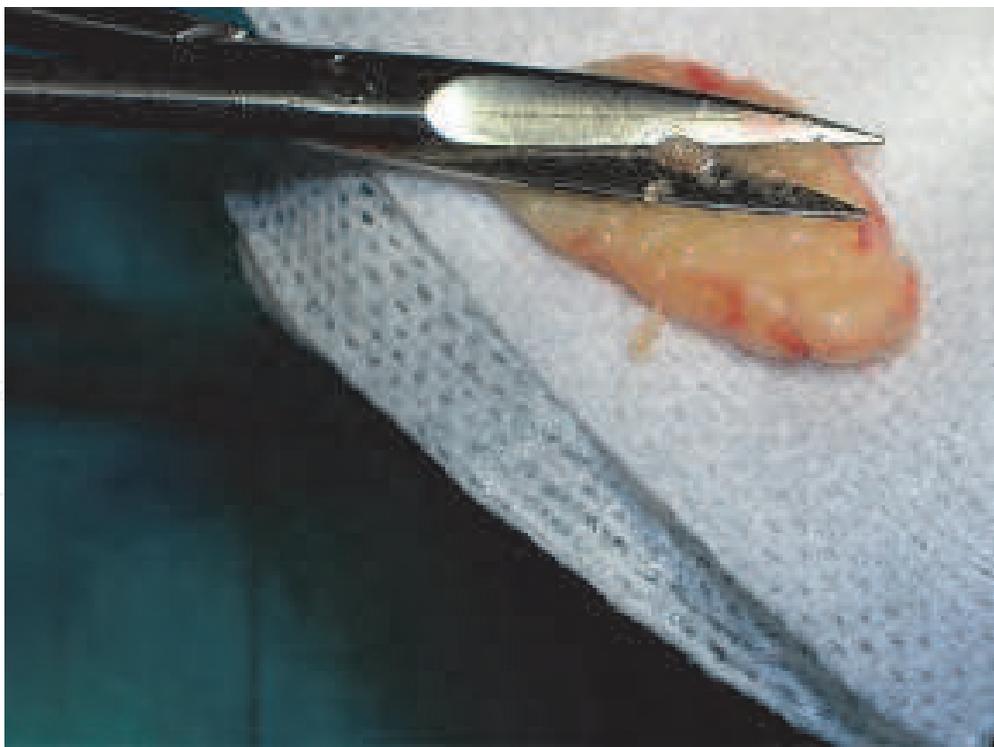


Fig. 4. Defatting of the graft performed with straight scissors.

The skin around the defect should be undermined several millimetres, before the suture of the graft, to prevent an excessive traction of the surrounding skin and a retraction of the

scar. This minimizes potential postoperative pin-cushioning and allows a uniform wound contracture.



Fig. 5. Defatting of the graft performed with curved scissors.



Fig. 6. Final appearance of skin graft after deffating. Notice the characteristic glistening white colour of dermis

Once the graft is ready for transfer to the receiving area, it is placed over the recipient area with the dermis side down. It is helpful to make a single central suture to fix the graft to the dermis to the recipient bed. This is done with an absorbable suture, preferably 4 / 0 thick. This promotes proper graft fixation to the recipient site with minimal risk of injury to the bed and subsequent bleeding (figure 7).

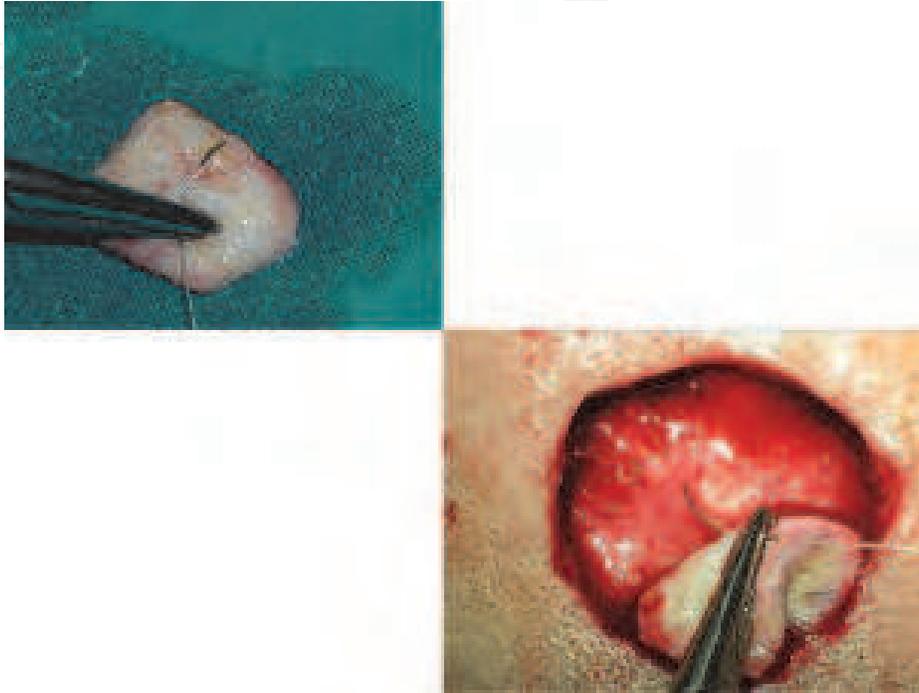


Fig. 7. Fixation of the graft to the recipient bed.

The optimal suture technique is first entering in the graft, 2-3 mm from the edge and exiting at the skin site adjacent to the defect, spacing stitches usually 4-5 mm in the adjacent recipient site skin and subsequently tied with 3-4 throws of a square knot. Simple interrupted sutures are generally used, even though a running stitch can also be used (figure 8). Simple interrupted sutures are recommended as we feel these allow for more precise apposition of the epidermal edges, although a running stitch can be used.



Fig. 8. Nasal graft showing a running stitch

While in other locations, tie-on bolsters remain good options to promote adherence of the graft, however, on the nose it is preferable to avoid bolsters because they are much more uncomfortable for the patient and are often not accurate (figures 9 and 10) . Hydrocolloid dressings applied directly on the graft are much more useful and provide for adequate gas exchange of grafted skin (figure 11).

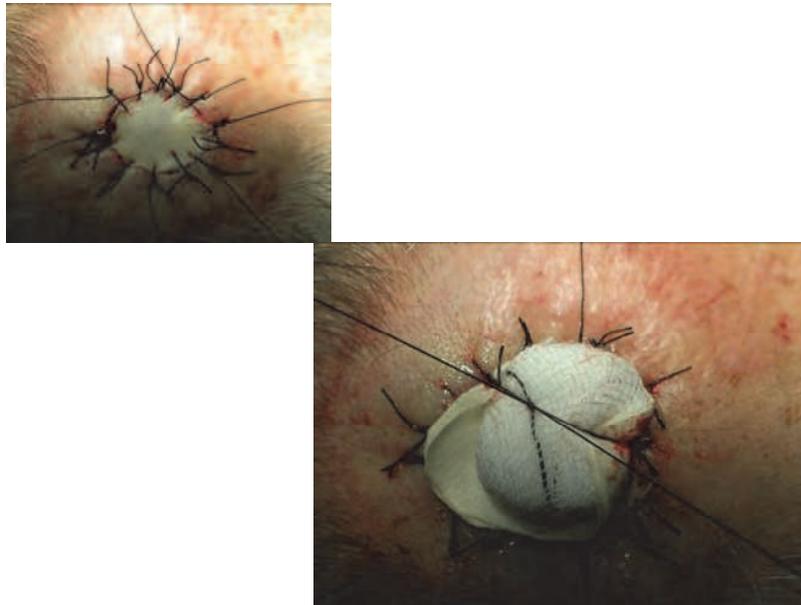


Fig. 9. Graft and tie-on bolsters.

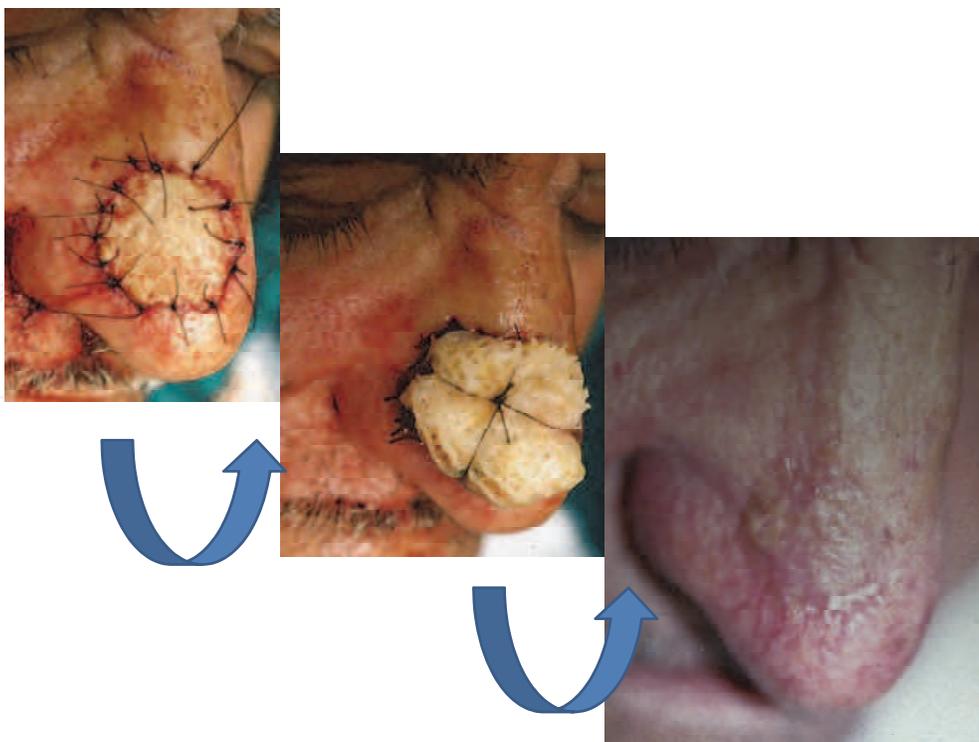


Fig. 10. Nasal graft with a tie-on bolsters. Final results five months later.



Fig. 11. Hydrocolloid dressings applied directly on the graft and donor area.

We usually use a thin layer of topical antibiotic, fusidic acid mainly on the graft, which is then covered with a hydrocolloid dressing (figure 11). A pressure dressing is then placed and remains in place for 48 hours, repeating the same process again, until the graft has ignited and can be left uncovered.

Finally the closure of the donor area is performed. In the case of nasal grafts, as previously mentioned, the skin will proceed, in most cases, from the glabellar or the preauricular regions, and in some cases from the clavicular region. In the case of the glabellar region, the closure is performed in vertical, perpendicular to the natural lines of the skin, but as it will not alter facial symmetry, aesthetic results tend to be acceptably good. In the other two cases it is easier to guide the scars parallel to the lines of relaxed skin tension, and hide the scars better (figures 12 and 13).



Fig. 12. Nasal graft taken from the glabellar area to repair a defect on inferior nasal dorsum.



Fig. 13. Nasal graft taken from the glabellar area to repair a defect on alar region.

2.2 Burow's grafts to repair nasal defects

Burow grafting is obtained from the skin adjacent to the defect and allows primary closure of a unit and second unit grafting, using skin with similar cosmetic characteristics.. They are primarily used in the reconstruction of large defects of the nasal dorsum, making the design of Burow's graft in the glabellar region. This will make direct closure of the glabellar region, suturing the graft inferiorly (figures 14-16).



Fig. 14. Burow's graft from glabellar skin to repair a defect on the upper nasal dorsum.



Fig. 15. Burow's graft from glabellar skin to repair a defect on the nasal dorsum and tip.

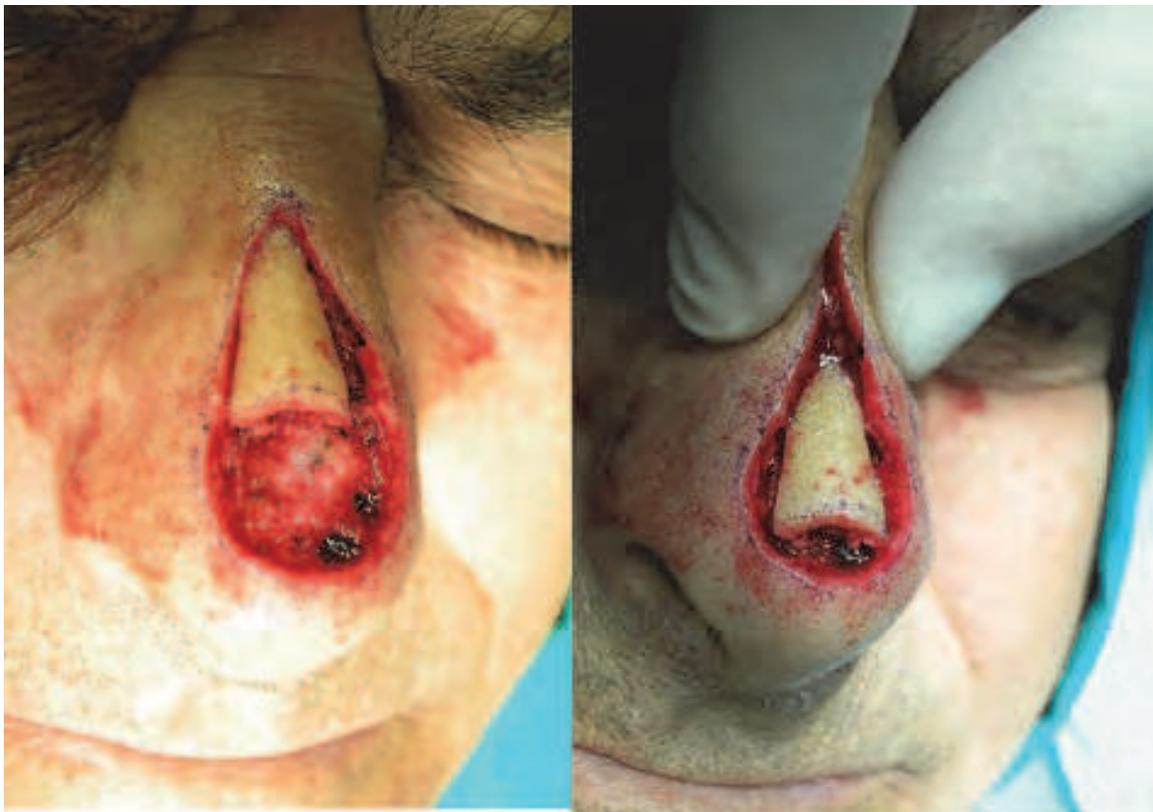


Fig. 16. Burow's graf from nasal dorsum to repair a defect on the nasal tip.

2.3 Partial thickness skin grafts on the nose

Partial thickness skin grafts contain full thickness epidermis and a variable amount, usually limited of dermis and often lack adnexal structures. Partial thickness skin grafts are further

classified by total thickness in millimeters, depending on the amount of dermis included in the graft. The subdivisions are thin (from 0.125 to 0.275 mm), medium (0.275 to 0.4 mm) and thick (0.40 to 0.75 mm). The majority of graft harvest for use in the region of the head and neck are usually 0.3-0.4 mm thick. The main advantages of such grafts include the ability to cover very large defects and the increased likelihood of graft survival, since they need less nutritional intake. In addition, these grafts are thinner and allow earlier detection of tumor recurrence in cutaneous oncology field. The main disadvantages include a less aesthetically desirable colour and texture match with surrounding skin and the need for specialized equipment. The degree of contraction is greater with partial thickness skin grafts than with FTSGs and creates significant granulation that requires more postoperative care.

2.4 Composed and cartilage grafts

The cartilage contributes significantly to the maintenance of the anatomical structure and function of the nose. Sometimes a significant amount of tissue and cartilage support to the nose is removed with oncological surgery, resulting in both structural and functional deficits that require reconstruction. Functional iatrogenic nasal obstruction is a particular risk when working in the wing and supra-alar crease, where the nasal valve is located. In most situations where the loss of cartilage results in a functional deficit, the cartilage must be replaced in order to facilitate the permeability of the nostrils. One method of restoring the lost structure is to use a composite graft or a free cartilage grafts and subsequently cover this with a skin graft, either the same day or several weeks later. If the perichondrium is preserved, the probability of survival of the cartilage will be higher.

A composite graft is a modified graft that contains more than one component of tissue, usually cartilage. However, the survival of composite grafts is dimmer than FTSGs. FTSGs revascularization occurs from vessels throughout the base and edges of the graft, whereas grafts composed only get their new blood supply from the subdermal plexus of the wound and the edges of the graft. Because of problems with vascularization, the size of a composite graft is limited to a maximum graft diameter ranging from 1-2 cm to minimize the risk of necrosis. In the nose, the rich vascular network quite compensates existing problems.

The probability of graft survival can be improved further by improving the basis on which the composite graft will be placed. A hinged flap on the base of the wound may increase the contact of the graft vessel with a suitable base. In addition, the wound can be allowed to heal for a period of several weeks by secondary intention. Particular attention must be paid to this fact, as an excessive contraction may imply functional problems. This is especially important in the nasal valve, so in this location, close monitoring during this phase of healing is required. Patient selection is also very important. We should proceed with caution in elderly patients, smokers, and those with conditions known to cause vascular compromise such as diabetes, vaso-occlusive disease, and prior ionizing radiation in the receiving area. These conditions can affect the peripheral blood flow and thereby decrease graft survival.

The use of composite grafts is the most commonly used graft in dermatologic surgery to repair defects of the nasal ala, sidewall, and the columella. Alar cartilage loss can lead to nasal valve incompetence and decreased stability of the wing so that during inspiration, nasal tissue is drawn into the nasal septum, resulting in decreased air flow and functional compromise. The cartilage is used as part of the graft to restore the structural integrity of the

wing and maintain the smooth functioning of the prevention of alar collapse during inspiration.

The crus of the helix is most commonly employed, although the helical rim, tragus, antitragus and concha can also be utilized. These areas of the ear has the most of the tissues of the nasal ala, the cartilage is thin and flexible, relatively thin overlying skin and subcutaneous tissue. For areas in the highly sebaceous distal nose are in favor of free cartilage grafts harvested from the ear, but without the skin attached to allow the tissue even better game so superficial, either from another instead of the nose or skin perinasal as a bilobed or nasolabial flap, or in the form of a skin graft melolabial. The shell is most commonly used for reconstruction of lateral nasal wall or nasal columella and large alar defects. The helical crus has the additional advantage of being thicker with a sebaceous texture and a composite graft works well for deeper defects sebaceous, making the nose look more true . (Table1)

NASAL DEFECT LOCATION	FULL-THICKNESS SKIN GRAFT DONOR SITE	CARTILAGE DONOR SITE
Tip, ala/alar rim, alar groove	Preauricular cheek, conchal bowl, melolabial fold, postauricular sulcus, supraclavicular area for larger defects	Conchal bowl, antihelix
Columella	Same locations as other nasal areas	Helical rim, crus, or antihelix

Table 1. Recommended donor sites for full-thickness skin grafts depending on the location of the nasal defect.

3. Conclusion

Nasal defects are a common challenge in daily practice. A multitude of benign and malignant lesions are located in the nasal region. Basal cell carcinoma is the most common skin cancer and is found frequently in this anatomical region. The size of defects secondary to excision of these lesions may not allow primary closure or reconstruction using skin flaps and requires the use of skin grafts. Skin grafts are particularly suitable for large defects occupying almost an entire cosmetic unit and, especially in elderly patients, produce acceptable cosmetic results in many cases.

Full-thickness skin grafts contain the entire epidermis and dermis and preserve adnexal structures, so they are very useful in the reconstruction of these nasal defects. The appropriate choice of donor skin is essential to achieve a cosmetically acceptable result and depends on the nasal cosmetic unit in which the defect is located and on the particular characteristics of the patient's skin. The location of donor skin most commonly used are the glabella and preauricular region, as well as the skin adjacent to the defect that can be obtained by Burow's technique.

Regarding technical aspects we recommend an adequate fixation of the graft to recipient site with a point made with an absorbable suture. Hydrocolloid dressings placed over the graft are particularly suitable in the first days after surgery as they allow an adequate gas exchange and collaborate in the establishment of the graft to recipient site.

In some cases complex reconstructions are need for big defects affecting the majority of the nasal skin, and skin grafts are always a good option alone or helped by skin flaps (figure 17).



Fig. 17. Basal cell carcinoma affecting the left half of the nose. We repair the defect a rotation flap from glabella and two skin grafts, from the right arm.

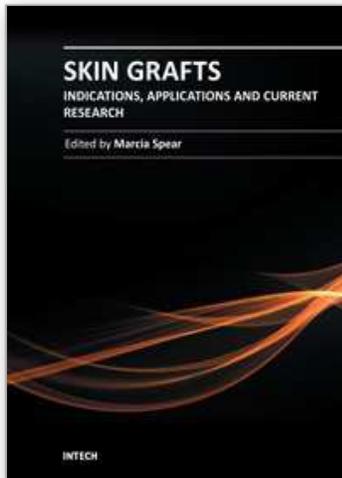
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The procedure of skin grafting has been performed since 3000BC and with the aid of modern technology has evolved through the years. While the development of new techniques and devices has significantly improved the functional as well as the aesthetic results from skin grafting, the fundamentals of skin grafting have remained the same, a healthy vascular granulating wound bed free of infection. Adherence to the recipient bed is the most important factor in skin graft survival and research continues introducing new techniques that promote this process. Biological and synthetic skin substitutes have also provided better treatment options as well as HLA tissue typing and the use of growth factors. Even today, skin grafts remain the most common and least invasive procedure for the closure of soft tissue defects but the quest for perfection continues.

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