Skin Flaps

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- Skin transposition
- Reconstructive surgery

Open wounds, particularly around the face, often require complicated techniques for optimal closure. The approach to the closure of the complicated wound depends largely on the nature of the wound, including the location and size of the defect, the functional outcome after closure, the medical comorbidities of the patient, neighboring structures, and whether the defect is secondary to a malignancy or trauma. The goals of wound management are optimal aesthetic outcome, preservation of function, and patient satisfaction.

The authors briefly review basic skin closure options and discuss use of skin flaps, particularly of the head and neck region.

**HISTORY OF SKIN FLAPS**

The earliest documented surgical intervention to rebuild a complicated defect occurred in India in 700 BC. Sushruta published a description of a forehead flap for nasal reconstruction. This information was not available to Western medicine until the late 1700s, when a British surgeon noted the technique still used in India and wrote a brief description in *Gentleman’s Quarterly*.

Independently, the Italians developed delayed flaps, tube flaps, and flap transfers by using the upper inner arm skin to reconstruct a nose. This technique was published by Tagliacozzi in the 1500s. In modern medicine, the use of local flaps to repair facial defects began to evolve during the mid-1800s. A variety of flaps were used, but the blood supply and the dynamics of the surgery were not well understood. Harold Gilles popularized tube flaps and flap delays and initiated an interest in reconstructive surgery after World War I.\textsuperscript{1}

Local skin flaps, such as those described in this article, were primarily refined in the 1950s in Europe and the United States by the second generation of plastic surgeons. Ian MacGregor\textsuperscript{2,3} recognized the importance of an axial blood supply in flap surgery in the 1970s. Plastic surgeons have subsequently redefined cutaneous blood supply.
Countless vascularized flaps have since been developed. The skin flaps discussed in this article are primarily random flaps.\textsuperscript{1-3}

**PREOPERATIVE PLANNING AND CONSIDERATIONS**

For each patient, a medical history encompassing smoking, peripheral vascular disease, atherosclerosis, diabetes mellitus, steroids, and previous surgeries should be elicited, because of the effects of these factors on wound healing and skin perfusion.

In managing the excisional defect, the surgeon must first assess the size and depth of the wound, as well as the nature of any exposed underlying internal anatomy. A defect containing exposed bone, nerves, or blood vessels usually necessitates a more advanced closure than would a less complicated wound.

The quality of the surrounding skin is also of great importance. Skin quality may vary from young, tight, and elastic to aged, dry, and lax. The wrinkled skin of an older patient produces less obvious scarring and offers the opportunity to conceal scars within skin tension lines. Skin that is more oily or heavily pigmented generally yields a less favorable scar. Color match is also of importance in deciding on the flap donor site. The presence of actinic damage, skin diseases, and premalignant satellite lesions should be considered. Finally, location is of major concern. Defects adjacent to critical anatomic structures, such as the eyelids, the nares, the oral commissure, and the external auditory meatus, must be reconstructed so as to avoid distorting the anatomy unique to those areas. Any alteration of these surrounding landmarks may compromise functional and aesthetic results. Previous surgical incisions and traumatic scars should also be assessed before the closure of the defect is designed.

Well-planned and -executed reconstruction of facial defects is particularly important because of the visibility of the result and the potential for functional deficits. However, the principles presented here may be applied to the management of all complicated wounds.

In the repair of facial tumor defects, the most important consideration is the management of the tumor. Incompletely excised tumor should not be covered by a flap. Skin adjacent to a tumor resection margin should not be turned over to line the nasal cavity or any other site where it will be difficult to examine. In patients who have a history of multiple or recurrent skin cancers, a strategy must be developed to allow for serial repairs. No bridges should be burned along the way. When planning a reconstruction, one must protect function first, then consider the cosmetic issues. It is crucial to discuss options with patients so that they can offer any biases that must be respected. A good-looking static repair that compromises dynamic function is unacceptable. The anatomic boundaries of the face are the allies of a good plastic surgeon. They must be respected and will be helpful in camouflaging scars.

Many defects can be treated with primary closure, secondary healing, or skin grafts. However, if, after careful assessment of the lesion, defect, and patient, the surgeon determines that the patient needs a flap for closure, he or she can apply techniques that produce the optimal aesthetic outcome.

**TUMOR RESECTION**

The paramount consideration in tumor excision should be the complete removal of the tumor. Although the surgeon should have a number of reconstructive options in mind, the planned reconstruction should not dictate the extent of tumor excision. The surgeon must remain open to alternative reconstructive techniques. If the defect obtained in excising the tumor cannot reasonably be reconstructed at the time of the
operation, the wound should be dressed and the reconstruction reconsidered and de-
layed, or the patient should be referred to another surgeon specializing in these
repairs. This option is clearly preferable to a suboptimal reconstruction.

BASIC SKIN CLOSURE TECHNIQUES

Undermining is performed to mobilize the tissue in areas surrounding the defect and to
facilitate the draping of skin over the wound. The use of undermining allows the
surgeon to move some portions of the wound and not others to avoid the distortion
of nearby anatomy, such as the nasolabial fold or the oral commissure. However,
because tight closures make for unsightly scars, alternatives should be considered
before undermining the edges of a gaping or complicated wound. Undermining can
destroy some of the options for flap repair. The reconstruction should be well planned
before any undermining. In addition, the surgeon can use closure of the defect in
layers to avoid any tension at the wound closure site that might result in dehiscence,
wound healing problems, or widened scars.

When using elliptic skin excisions, one should make the long axis four times greater
in length than the smaller axis. When an ellipse is made too short or one side of the
eclipse is of unequal length, the skin may bunch at one end of the closure. This effect
is known as a dog ear. In any wound, whether its sides are of equal or unequal length,
the ends of the defect should be closed first to avoid unnecessary dog ears. Any
redundancies can be dealt with in the middle of the wound during closure. Irregulari-
ties or pleats in the midportion of the wound generally resolve over time. Excising dog
ears when they occur is simple. This excision is accomplished by extending the elliptic
excision or by cutting the corner of the excision into a Burow’s triangle. Alternatively,
placing a small right angle or 45° bend in the affected end of the wound closure can
produce a satisfactory result. Finally, a V-shaped excision of the lateral ellipse can
be used, resulting in an M-plasty closure.

RECONSTRUCTIVE OPTIONS

The final outcome in any closure depends on the proper assessment of the defect and
the selection of an appropriate closure technique. Primary closure involving direct
approximation of the wound edges is a first option. An intermediate closure consists
of approximation and closure of deeper tissue levels before final skin closure.
Complex closure entails approximation and adjustment of the wound edges by means
of undermining, the excision of any dog ears, or trimming of wound edges before
closure. Finally, the options of skin grafting, allografting, and flap repair must be
considered.

When a wound cannot be closed primarily, the options are as follows: secondary
wound healing, skin grafting (discussed elsewhere), or local tissue transposition. Healing
by secondary intention consists of two phenomena. The major means of size
reduction of the defect is wound contracture, accompanied by re-epithelization to
a lesser extent. Wound contracture may result in distortion of nearby mobile anatomic
features, such as the oral commissure or the epicanthi. The contraction of scar tissue
alters the orientation of the surrounding normal anatomy, which may result in an unac-
ceptable cosmetic outcome and, more importantly, in poor function.

Healing by secondary intention is a viable option in fixed areas away from important
anatomy, such as the middle of the forehead, the cheek, or the neck. In areas adjacent
to important, easily deformable anatomic structures, transposition flaps are often
a better wound closure approach.4,5
SKIN FLAP COVERAGE

Local skin flaps offer several advantages. Well-designed flaps borrow skin from areas of relative excess and transpose it to fill a defect. The skin provided is a close match in both color and texture, the donor site can be closed directly, and scar contracture is minimal. However, these flaps require experience and planning. Preliminarily drawing two or three flap design options for the defect may provide the surgeon with the best visualization of the optimal choice of flap for the particular area and defect. The choice of flap depends on the location and size of the defect, the quality of the surrounding skin, and the location of adjacent excess tissue. One should anticipate the appearance of the donor site scar and, when possible, plan to leave the scar in a natural crease line (eg, the nasolabial fold). When one raises the flap and moves it into the defect, key sutures should be applied and the overall flap position should be evaluated. If there is distortion of adjacent structures, one should reposition the key sutures and re-evaluate again for optimal position and least degree of tension. In addition, once the flap is in place and tacked down with temporary key sutures, it should be assessed for adequate perfusion. Further adjustments may be necessary. Closing the donor site first will relieve tension at the inset location. For example, closure of the Y lower limb in a V-Y flap helps push the flap to the inset position, and suturing on the bias further helps advance the flap into its recipient position. Once the final position of the flap is determined, it can be inset using the basic techniques already mentioned.

FLAP CLASSIFICATION

Flaps were first classified as random or axial by McGregor and Morgan in 1973. Random flaps had no specific vascular supply. Axial flaps had an arterial and venous blood supply in the long axis of the flap. Further contributions to the classification of flaps were made by Daniel and Williams, Webster, Kunert, and Cormack and Lamberty. A random cutaneous flap’s blood supply is derived from the dermal-subdermal plexuses of blood vessels, which originate from direct cutaneous, fasciocutaneous, or musculocutaneous vessels. One example is the rhomboid flap. The arterial, axial, and direct cutaneous flaps are based on septocutaneous arteries. These septocutaneous arteries come either from segmental or muscular vessels, pass through the fascia between muscles, and provide blood supply to the fascia and skin. They also give off branches to the muscle. The cutaneous portion of the septocutaneous arteries runs parallel to the skin surface and has venous comitantes running along with the artery above the muscle. An example is a forehead flap. In summary, survival of the skin flap is dependent on the vascular anatomy incorporated in the flap.

TRANSPOSITION FLAPS

Local transposition flaps involve the movement of adjacent skin from an area of excess to the area of deficiency. These flaps involve the transfer of the flap through an arc of rotation on a pivot point in a linear axis. Regional tissue laxity and mobility are of greater importance than the precise angular/geometric measurements. In addition, the flap should be designed to fit the defect with minimal tension at the closure line, to avoid distorting the neighboring structures, and to have an adequate base to perfuse the undermined, elevated flap. The rule of thumb is that the random pattern transposition flaps should not have a linear axis longer than three times the width of the flap. Rhomboid flaps, Z-plasties, and W-plasties are variations on the transposition flap. They involve the transposition of a random skin and subcutaneous tissue flap into an adjoining defect. These flaps are designed so that the donor scar is well
camouflaged. They must be meticulously designed according to the specific requirements of the reconstruction. However, transposition flaps are quick and easy for the experienced surgeon and are versatile solutions to many coverage problems. Particular areas well-suited to transposition flaps include the glabella, temple region, scalp, and lower third of the nose. Smokers and other patients with vascular compromise are at risk for flap necrosis.\textsuperscript{13,14}

\textbf{Banner Flap}

The banner flap (\textbf{Fig. 1})\textsuperscript{15} is a transposition flap designed as a pendant of skin tangential to the edge of a round defect. The flap is elevated, and the donor site closed. The flap edges are then trimmed to fit the defect better, and the flap is inset.

The bilobed flap (\textbf{Fig. 2})\textsuperscript{16–20} is a variant of the banner flap in which two adjacent segments are raised, one smaller than the other. The two flaps are oriented perpendicularly to each other. The smaller flap (usually half the diameter of the larger flap) is used to fill the larger donor site, and the small donor site is closed primarily. The original defect is then closed by means of the larger of the two lobes. The final result is the \(180^\circ\) rotation of excess tissue to fill the skin deficit. Bilobed flaps are most commonly used in the closure of nasal defects, particularly in the lower third, and they are a means to transfer excess adjacent skin into the area of deficiency. Defects that cannot be covered using a single transposition flap because of tension can be closed by this method. One must be aware that these curvilinear incisions will not necessarily fall into pre-existing skin folds or wrinkles.

\textbf{Fig. 1.} The banner transposition flap. The flap is designed tangential to the defect and the donor site closed primarily.
Rhomboid Flap

Rhomboid flaps (Fig. 3)\textsuperscript{21–25} are rhomboid-shaped skin flaps transposed into like-shaped defects leaving an angulated donor site, which can then be closed primarily. A corner of the rhombus is extended at a length equal to one of the short diagonals. This new limb is joined by another at a 60° angle. Because all rhomboids possess four corners that can be extended, any rhomboid defect is amenable to any of eight possible rhomboid flaps. The end result is a scar of geometric appearance, which is best when hidden in the natural crease lines of the skin. Although the customary angles are 60° and 120°, variations of the rhomboid flap using 30° and 150° angles are possible. These variations allow for coverage of rhomboid defects with unequal sides. Because this approach involves more meticulous planning, it is sometimes simpler to begin by converting the defect into a rhombus of 60° and 120° angles. The area of maximum tension is at the closure point of the donor site flap. The vector of maximum tension has been determined to be 20° to the short diagonal of the rhomboid defect. Every rhomboid defect has eight potential flaps for closure, and it is up to the surgeons to decide which donor site is optimal.

When a larger wound needs to be closed, the circular defect can be converted into a hexagon and closed with three rhomboid flaps. This procedure is even more complicated to plan, and it leaves a stellate-shaped scar. The scar is difficult to merge into natural crease lines and is consequently noticeable as a geometric scar. This technique should be used with caution.

Z-plasty

The Z-plasty (Fig. 4) is a double transposition flap that is often an appropriate option in scar revision or in the release of scar contractions. These flaps are well suited to the
correction of skin webs and the disruption of circumferential scars or constricting bands. Furthermore, the Z-plasty elongates the operated tissues.

The Z-plasty entails the exchange of two adjacent triangular flaps. The incision consists of a central limb and two limbs oriented to resemble a Z. All limbs are the same length to facilitate closure. The length of the central limb dictates the absolute gain in length after Z-plasty, whereas the angles chosen determine the percentage of length increase. The typical Z-plasty has 60° angles, resulting in a gain in length of 70% relative to the central limb. The angles may range from 30° to 90°, providing gains in length of 25% and 120%, respectively. However, these gains are theoretic. Smaller gains are seen in practice because of restrictive skin factors. Because the Z-plasty relies on healthy adjacent skin, it is usually a poor choice for the correction of burn scar contractures. However, the gain in length granted by the Z-plasty is well suited to other scar contractures, and the changed axis of the final scar often provides a more desirable aesthetic result in facial scar revision.

When laying out the Z-plasty, one should plot the final position of the central limb first. This final position is perpendicular to the original central limb incision and should be oriented parallel to the skin lines. Consecutive Z-plasties result in further transposition of skin and obliteration of straight-line scars. Multiple Z-plasties produce transverse shortening and lateral tension on the wound.

**W-plasty**

The W-plasty is similar to a Z-plasty in its ability to break up a linear scar. A defect is created by removing a scar or lesion in a precise, premarked zigzag pattern that creates multiple small triangular flaps. The multiple triangular flaps are interposed among one another. The base of each triangle is aligned with the vertex of the one opposite. Unlike the Z-plasty, the W-plasty does not confer any gain in length on
the contracted scar line. As the ends of the scar are approached, the triangles should decrease in size, and the limbs of the triangles should decrease as well.

**ROTATION FLAPS**

Rotation flaps (Fig. 5)⁴,¹³,²⁶ are semicircular flaps raised in a subdermal plane and rotated from the donor bed around a pivot point adjacent to the defect. The defect site is visualized as a triangle with its base as the shortest side. After the flap is rotated into the defect, the donor site is closed primarily, yielding an arcuate scar. Considerable tension may be present in this flap and needs to be recognized. The line of maximal tension is directly opposite the pivot point and adjacent to the defect. Excessive tension along this line may result in ischemia and subsequent necrosis of the flap. Rotation flaps require considerable planning, and little gain is realized relative to the

![Fig. 4. Z-plasty.](image)

![Fig. 5. Rotation flap.](image)
size of the flap. In some cases, the donor site cannot be closed primarily and may require a skin graft. However, depending on the location of the defect, rotation flaps may be preferable to transposition or advancement flaps.

A problem with rotational flaps is the unequal length between the edge of the flap and the entire edge of the primary and secondary defects. To correct this mismatch in length, one can use the Burow’s triangle technique, a cutback incision, advancement of the flap while rotating it, or suture on the bias to stretch the flap forward. The rule of thumb is that the length of the flap should be four times the width of the base of the defect. In addition, the ideal defect for repair has a height to width ratio of two to one. The blood supply is usually random, but if the surgeon designs the position of the base of the flap, it can be axial.

ADVANCEMENT FLAPS

Advancement flaps involve raising a skin paddle in a subdermal plane and moving its leading edge into the defect. The movement of the flap is longitudinal rather than rotational and is directly over the defect. Complete undermining of the flap is very important. Burow’s triangles are often excised at the base of the flap to remove dog ears as the flap advances relative to the surrounding skin. These flaps have limited coverage potential and utility. The single-pedicle advancement flap is the basic flap. The ratio of defect length to flap length is one to three. Bilateral advancement flaps may be used if a single flap does not provide adequate tension-free closure of the defect.4,13,14

V-Y Plasty

V-Y plasty (Fig. 6)27,28 is a variation of the advancement flap. In a V-Y plasty, the skin flap is not elevated and remains attached to the underlying subcutaneous tissues. A V-shaped flap is designed adjacent to the defect. The surrounding skin is elevated, and the V-shaped tissue is advanced into the wound. The donor site is closed primarily, yielding a Y-shaped closure. It may be necessary to trim the triangular edges of the leading flap to fit into the defect. This technique is particularly well suited to elongating the nasal columella and correcting the whistle deformity of the lip. The V-Y flap is one of the most versatile skin flaps and is widely used in all areas of the face.

Island Flap

Island flaps, as their name implies, involve the transposition of an island of skin that is raised on its blood supply. The skin island is moved into the defect, and the donor site is closed primarily. Often, this involves tunneling the flap under adjacent skin on its vascular pedicle. The flap island should be approximately the size of the defect to

Fig. 6. V-Y advancement flap.
be covered. In areas such as the eyebrow, the island flap provides a supply of like tissue without permitting the distortion of normal anatomy. A circular island flap may pin-cushion. This complication can be avoided with proper planning.4,13,14

**T-plasty**

T-plasty is an advancement technique that converts a triangular or circular defect into an inverted-T scar. It is essentially a bilateral advancement flap and works well in the central forehead, above the eyebrows, and on the upper lip just above the vermilion. Care must be taken, because the vertical limb of the T can be noticeable in some areas.13

**CLINICAL SCENARIOS**

Many options are available for closing defects of the face and other areas of the body; the authors outline only a few of them here. The reconstruction of each defect must be individualized to attain the optimal aesthetic outcome. In each of the following clinical cases, multiple skin flap options are discussed for each defect. These are, of course, not the only options, and the selected reconstruction is not the only good choice. The principles of selecting an appropriate repair are the same in each case.

**Fig. 7A** depicts a 65-year-old woman who underwent excision of basal cell carcinoma and now has a 2.5-cm defect in the side of her nose. Aesthetic reconstruction of nasal deficits is a common problem posed to the reconstructive surgeon by the high
incidence of nasal skin cancer. Several considerations need to be addressed in the reconstruction of nasal defects: color and texture match, minimization of bulkiness, appreciation of discrete aesthetic units of the nose, skin tension lines and wrinkles, adequacy of tissue, and vascularity.

The glabellar skin offers an excellent source of tissue for nasal repairs. The transposition glabellar flap provides good skin match and adequate skin to cover this defect, and the glabellar region can be closed primarily with a vertical scar orientation at the donor site that can be easily camouflaged.

The incision can be made along the nasolabial groove and along the cheek, following natural skin lines, to raise an advancement flap. This flap is advanced medially to cover the defect. The cheek has good skin laxity to close the defect at its base. However, the bulkiness of the cheek relative to the nasal skin may be obvious.

A nasolabial flap can be elevated in the subcutaneous plane of the cheek and transposed to the defect. In this case, a dog ear needs to be excised at the pivot point superiorly. The cheek has to be undermined beyond the flap to allow for transposition of this flap. The donor site can be closed primarily, with the closure falling along the nasolabial fold. Closure of the donor site would disrupt the eyelid-cheek skin lines.

A bilobed glabelar flap can be used, as in this case (Fig. 7B), to cover the defect. The smaller lobe is transposed to cover the donor defect. The rest of the glabelar region site can be closed primarily in a Y fashion. Good skin color and texture match are seen, with minimal tension and good camouflage of scars (Fig. 7C).

Fig. 8A shows a 62-year-old man with a cheek defect after resection of squamous cell carcinoma. The defect is 4.5 cm in size and lies 3.5 cm lateral to the mouth.

An advancement flap may be designed, based either laterally or inferiorly, to close this defect. Parallel incisions can be made, raised in the subcutaneous plane, and advanced to cover the defect. Good laxity of the skin of the cheek, especially in the elderly, provides sufficient tissue for the repair. Dog ears at the base of the flap can be excised. The inferiorly based advancement flap takes advantage of the laxity of the skin of the neck, and the scar lines fall in the natural skin lines. Hence, the inferiorly based advancement flap is a better option than the laterally based one.

A banner flap can also be used to transpose into the defect. However, the scar may not be as easily camouflaged.

Other options include (1) a cheek rotation flap, (2) a rhomboid flap inferiorly based to take advantage of the lax skin of the neck, and (3) a V-Y advancement flap based laterally (Figs. 8B and 8C).

In the patient shown in Fig. 9A, the defect is centrally located in the dorsum of the nose. Several good options are available for its reconstruction.

A superiorly based V-Y advancement flap may be used.

A rotation glabellar flap may be used and a backcut designed to close the donor site pivot point in a Y configuration (Fig. 9B).

A rhomboid flap would not be the ideal design, because the nasal skin is not as mobile and may distort the medial canthus and create a web or ectropion. It is important that the design of the flap in this patient lie within the wrinkles of the face to mask the scar and not distort the eyebrows and eyes.
A banner flap may also be designed, using the tissue available from the side wall of the nose and primary closure of the donor site.

**Fig. 8.** (A) A 62-year-old man with a cheek defect after resection of squamous cell carcinoma 4.5 cm in size. (1) Advancement flap based laterally or inferiorly with excision of Burow's triangles. (2) Banner flap. (3a) Cheek rotation flap. (3b) Rhomboid flap. (3c) V-Y advancement flap. (B) Intraoperative photograph of patient after the V-Y advancement flap of the cheek defect. (C) Postoperative photograph of patient after the V-Y advancement flap of the cheek defect.

**Fig. 10A** shows an 85-year-old woman after resection of basal cell carcinoma from her upper lip, creating a 1.5-cm circular defect. This defect lies just above the vermilion and medial to the nasolabial fold and is close to the alar base, philtrum, and cupid's bow.

**Fig. 9.** (A) Patient with a dorsal nose defect. (1) Superiorly based V-Y advancement flap. (2) Rotation glabellar flap and a backcut to close the donor site. (3) Rhomboid flap. (4) Banner flap. (B) Intraoperative photograph of rotation glabellar flap with a backcut to close the donor site in a Y-fashion.
A bilateral V-Y advancement flap may be used to close the defect with adequate undermining. Excellent laxity of the skin and natural skin folds and wrinkles are present and may be used to the surgeon’s advantage. However, the medial V-Y flap may distort the cupid’s bow.

An A-T advancement flap may also be used, by taking a triangular wedge out superiorly from the defect and undermining on both sides to close the defect.

A nasolabial flap may be used by raising the flap along the nasolabial fold.

A single V-Y advancement flap was designed, following the vermilion border and the nasolabial fold to advance medially into the defect (Figs. 10B and 10C). A rhomboid flap, in this case, would distort the nasolabial fold and would not mask the scar as well.

**FOLLOW-UP CARE**

Follow-up care is an important aspect of the treatment of any surgical wound. Suture removal is timed to prevent suture cross marks and epithelial cysts. Patients need to be advised as to the proper management of new scars and monitored to ensure that the healing process is progressing normally. As in the treatment of any condition, follow-up and continuity of care are vital aspects of good medical practice. Skin flaps take 3 to 6 months to mature. They tend to look puffy and distorted at first but will settle down and improve over time. Patients need to be reassured.

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Fig. 10. (A) An 85-year-old female after resection of basal cell carcinoma from the upper lip with a 1.5-cm defect resulting. (1) Bilateral V-Y advancement flap. (2) A-T advancement flap. (3) Nasolabial flap. (4) Single V-Y advancement along the nasolabial fold and vermilion border. (5) Rhomboid flap would distort the nasolabial fold to a greater degree than the other flaps mentioned. (B) Intraoperative photograph of V-Y advancement flap in the upper lip. (C) Postoperative photograph of V-Y advancement flap.
EARLY COMPLICATIONS OF FLAP RECONSTRUCTION

The possible complications after flap reconstruction vary in severity and require distinct approaches depending on their type. Fortunately, most of the complications are preventable as well as amenable to treatment. The most common early complications after skin flap reconstruction surgery are infection, hematoma, seroma, and wound dehiscence.

The complication of flap necrosis is more serious and is usually due to a design flaw or an error in execution of the reconstruction. These errors include the use of too small a flap for a given defect, damage to the flap’s blood supply, extension of the flap beyond its blood supply, or closure of the defect in such a way that it is subject to too much tension. Flap necrosis may usually be avoided by means of more precise flap design and avoidance of undue tension on wound closure. Treatment of distal necrosis is conservative and may include allowing certain areas to heal by secondary intention or subsequent surgical revision of the area. However, in areas where the flap was placed to prevent a deforming scar contracture, such as the eyelid, a new reconstruction should be performed as soon as the wound condition permits.

LATE COMPLICATIONS OF FLAP RECONSTRUCTION

These complications are avoided for the most part by means of experience and careful planning of the flap reconstruction. Unfavorable scarring is a complication that occurs when scars are placed outside of the direction of the skin tension lines. Scars that lie in the wrong direction may be revised with a Z-plasty or a W-plasty. Pin-cushioning (trap door deformity) of the flap is another complication that arises from a curvilinear scar. Correction of the pin-cushion deformity should not be performed until the scar matures. Options for correction include excision of the old scar, defatting of the flap, and closure with Z-plasties or a W-plasty.

Hypertrophic scars are uncommon on the face. However, keloids can be a major concern. Any patient with a personal or family history of keloids or a personal history of hypertrophic scars must be warned about the risk of developing additional keloids or hypertrophic scars. Once a keloid forms, many treatment options are available, most of which are only partially effective in minimizing the scar. Pressure, topical silicone, steroid injections, and massage are the standard treatments, although re-excision in conjunction with intralesional steroids and postoperative radiation may also be considered for unresponsive lesions.

OUTCOME AND PROGNOSIS

When local flaps are insufficient to cover a wound properly, distant tissue may be imported using techniques such as skin grafting, pedicled flaps, axial flaps, fasciocutaneous flaps, myocutaneous flaps, and free flaps. If the removal of sutures that are too tight or the correction of a hematoma delays the repair, this is a small price to pay for the avoidance of flap necrosis and a better end-result. The primary goal in tumor surgery is adequate treatment of the tumor. Only after that treatment may a definitive reconstruction be undertaken. The reconstruction must preserve function and provide the best possible cosmetic result.

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