Facial Trauma and Reconstruction

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Soft tissue injuries of the Face

Facial injuries per se are seldom life threatening but can certainly be a serious threat to the victim's immediate and future physical as well as emotional wellbeing. Apart from the obvious functional consequences that can potentially result from a facial injury, there are breathing, mastication, speech and vision deficits that need to be addressed. Aesthetic restoration of the face is an important goal since the greater the facial deformity, the greater the social disability. Severe facial deformities can lead to near total social isolation for the patient due to rejection by society. This is true for dwellers in the most modern cities of the world as well as for those in the deepest jungles.

The facial tissues are unique in shape, texture and color. A particularly unique feature in its anatomy is the close association of the skin with the underlying muscle architecture constituting the unique combination of function, facial expression, and aesthetics. Whenever possible, local tissue should be used for repair and reconstruction. Local reserves are certainly available e.g. a lower lip can be repaired with direct closure even when up to a third of the lip is lost or with upper lip tissue loss the lower lip can be utilized for reconstruction (i.e. Abbé flap). To use tissue from distant sites is a last resort but sometimes the only option with major tissue loss.

Facial injuries often occur in isolation and can be dealt with under controlled circumstances and at an appropriate time for an optimum outcome. But, these injuries can also present as part of major head and neck trauma or in the multiple trauma patient with concomitant head injury, trauma to the airways, chest injuries or injuries causing major blood loss. These vital organ and system injuries by their nature demand priority over facial injuries; however, facial injuries should be treated definitively as soon as feasible, preferably within the first 6 hours, and certainly within the first 48 hours. If closure is delayed because of major trauma, then antibiotic therapy would be indicated.

Patients presenting late (after 48 hours) will need débridement and then closure once the wound is clean.

An Approach to Facial Injury

It is important to remember that once a muscle is cut, it will retract because of its inherent muscle tone. Facial skin is attached to the underlying muscle (panniculus carnosus) for facial expression, so as the muscle retracts, and the defect often appears to be much larger than the actual tissue deficit. In addition, the elasticity of the dermis also pulls the wound apart.

Whether or not general anaesthesia is used, lidocaine with adrenalin/epinephrine 1:100,000 local infiltration should be used both for pain control as well as for wound edge vasoconstriction which facilitates visualization. The surgeon should
wait at least 7 minutes after infiltration for effective vasoconstriction. The wound is then cleaned and carefully assessed before approximating wound edges. Traumatic flaps must be rotated back to their original position very much like fitting the pieces of a puzzle together. Usually, it becomes apparent that there is little to no actual tissue loss when the wound is closed, though, initially, the perceived loss was great due to the muscle retraction. Wounds are carefully sutured in layers with care to close muscle fascia, deep dermis, and epidermis. It is very important to put in buried deep dermal sutures prior to the superficial skin sutures. If there is tissue loss, then immediate flap closure with local tissue may be possible if the acute wound is clean. If not, staged washouts and débridements are indicated until the wound is clean. Then, either flap reconstruction or skin grafting can be done. The elastic facial skin is quite mobile, and large defects can usually be closed primarily or with local flaps. Skin grafting is rarely necessary.

If repair cannot be done within the first 12 hours due to other systemic injuries, it is appropriate to treat the patient with an antibiotic such as amoxicillin-clavulanate (Augmentin) which covers the oral flora as well as Staphylococci. With gross contamination or doubtful tissue viability, the aim should be to acutely débride and repair the wounds within the first 48 hours after injury. If the wounds are badly contaminated, crushed, or presenting outside the first 48 hours, the wounds should be débrided and dressed with a moist dressing with plans to return to the operation room within 48 hours for further cleaning and débridement. When clean, the wound should be closed or reconstructed with local or distant flaps or skin grafts. The delayed primary closure should be carried out before 7 days. (See Chapter 2) In the closure of complex facial injuries, as the case below, one should start the closure at the periphery and then suture toward the center of the wounds.

Motor vehicle accident: Initially the eyelids could not be identified as they had been avulsed from the lateral canthus. As the wounds were closed from the edges, the eyelids were identified and the lateral canthus was reattached to the inside of the lateral orbital rim. Very little tissue was lost and very little needed to be débrided. Fig 2 is one week later and Fig 3 is two weeks later. The patient was able to slightly open the left eye on discharge. Arrow in Fig 1 points to the eye.

Soft-tissue trauma may vary in degree of severity, but can generally be categorized as: contusion, abrasion, puncture, laceration, avulsion or accidental tattoo. **Contusions, abrasions, and puncture wounds** can usually be managed by cleansings and protective dressings. If a **hematoma** is apparent it should be evacuated and not allowed to resorb. **Retained foreign bodies** and **accidental tattoos** require removal of the embedded foreign material. The exception to this is **metal fragments from missiles**. Bullets or missile fragments are usually sterile.
and commonly penetrate deeply; more harm is done to the tissues with attempts at removal than from leaving them in place.

After wound cleansing and irrigation, simple lacerations are treated by primary closure. When wound edges are beveled or when there is obvious devitalized tissue, appropriate debridement is performed. Sharply beveled wounds containing vital skin for closure should be closed in one layer. It is difficult to place deep dermal sutures and line up the wound edges. Most facial wounds should be managed with very conservative debridement. Questionably viable facial tissue will often survive because of the excellent blood supply of the face. Unnecessarily aggressive debridement may result in the loss of vital soft tissue needed for repair. It is important that soft-tissue repair is done with careful attention to symmetry of facial features. Tissue should always be returned to its position of origin.

A traumatic **avulsion flap** occurs from an undermined laceration; its blood supply restricted to its skin attachment. If the flaps are small, they can be totally excised. Larger avulsion flaps should be preserved if possible. The thinnest peripheral portions of the flap should be excised to form perpendicular edges and the flap sutured in position. This should be done even if the viability of the flap is not certain – a final decision can then be made post-operatively with serial examinations.

When anatomical approximation is not possible because of loss of tissue, coverage by skin grafts or flaps would be necessary and done as a primary surgical procedure when the wound is clean.

When a defect is relatively small and the base is clean, a **full-thickness graft** can be a good option for coverage with elastic properties, thickness, and color closely resembling adjacent skin. Full-thickness grafts are usually taken from areas close to the face and where the donor site can be closed primarily such as the pre- or post-auricular areas, upper eyelid, and supra-clavicular area. When small defects cannot be closed, local flaps rather than skin grafts should be used if available. **Split-thickness grafts** are used for defects with a less than ideal recipient bed as
thin grafts tend to vascularize more readily but will result in greater graft contraction and poorer color match. These are rarely used on the face.

Flaps are used where more bulk is required for contour or if bone is exposed, and these can be:
- rotation advancement
- transposition
- direct or tubed pedicle
- island pedicle
- free direct transfer (microvascular anastomosis)

**Reconstruction of Different Anatomical Areas of the Face**

I. **Reconstruction of the Lip, Oral Commissure, and Cheek**

The lips are important for oral competence, for articulation, expression of emotion, sucking, and playing of various musical instruments. The lips are also important sensory organs in that they provide pleasure and protect the oral cavity from ingestion of unacceptably hot or cold materials.

Functional and aesthetic restoration of deformed parts is, therefore, very important, and the aims of reconstruction in the lips and cheeks are both for the restoration of form and reinstitution of function. This often involves the repair of several layers of missing tissues, and, if lost, the need for reconstruction in order to achieve a good final result.

The external landmarks of the lips (Fig 5) are the philtral columns (black arrows) and interposed philtral dimple (2) extending from the columella of the nose down to the Cupid's bow (1) at the central upper vermilion border. The central portion of the upper lip has a central tubercle (6). The upper and lower lips are joined laterally at the commissures. The upper lip is set apart from the surrounding cheek by the naso-labial fold (3); the lower lip is divided from the chin by a curved
mental crease (4). The naso-labial and mental creases are important to facial aesthetics and afford locations for camouflaging scars.

The lower lip has no structure at its center or shape to draw attention to asymmetry unlike the upper lip. The lower lip can sustain a loss of one-third of its breadth before tightness or asymmetry begins to show.

In contrast is the symmetry of the upper lip derived from its Cupid’s bow and its symmetry in relation to the nose, important factors to consider in repair and reconstruction. It is only possible to close small defects without producing a cosmetic deformity sufficiently obvious to be unacceptable. The upper lip in the normal face also protrudes in front of the lower lip and any post- excisional tightness which reduces or eliminates this normal relationship is not acceptable.
The lower lip can be used as a source of tissue to reconstruct the upper lip. In the case above, Fig 9 and 10, an Abbé flap can be used later for secondary reconstruction of upper lip midline. See under Abbé flap below.

The lips have a rich blood supply. Each lip has an artery which consistently runs parallel to the margin. This artery arises from the facial artery on each side and anastomoses to the other in the mid-line (Fig 11). The labial arteries lie between the orbicularis muscle and the mucous membrane at the level of the junction between ordinary skin and the red margin-mucocutaneous line (Fig 12). These vessels make it possible to transfer large sections of the lip on a pedicle which contains little more than the vessels themselves.

![Fig 11](image1.png)  
Labial Artery – Branch of the Facial Artery  
(From Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission)

![Fig 12](image2.png)  
Note the position of the Labial Artery on the oral side of the Lip  
(From Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission)

2. Loss of Lower Lip Tissue

♦ If less than a third of the lower lip is lost, direct closure in three layers can be done (mucosa, muscle and skin) without significant functional or aesthetic consequences. In significant but partial thickness loss of less than a third of the width of the lip, the best result is often achieved by converting the defect into a full thickness defect by a full thickness V-excision and direct repair in layers similar to the central upper lip defect repair above.

![Fig 13](image3.png)  
Separation of skin from muscle  
(Fig. 10 and 11: Repair of lower lip in three layers  
(Rob and Smith Operative Surgery—Plastic Surgery, Elsevier) Used by permission)

![Fig 14](image4.png)
One third of lower lip missing from human bite:
Wedge resection and direct closure with short advancement flaps from both sides

♦ **Cheek Advancement Flaps**

If more than one third of the lower lip is lost the least complicated and very effective reconstruction is the Karapandzic flaps below.

♦ **Karapandzic flaps**

These flaps are full thickness lip advancement flaps that also preserve the nerves. Karapandzic flaps may be taken from one side or both sides to close lower lip defects with like tissue. The incisions are full-thickness up to the commissure/angle where they become superficial to the muscles to preserve
the nerves and labial vessels. See right hand view above. It can be further extended into the upper lip along the nasolabial folds. This is an excellent reconstruction as it preserves continence and the orbicularis muscle. The stoma is smaller but it will expand over time and eating will not be a problem. Reverse Karapandzic flaps with partial upper lip reconstruction is also possible.

![Fig 21](Lip SCC with resection and wide reconstruction with Karapandzic flap)

Here is another method of mucosal advancement and vermillion reconstruction with relaxing incisions around the chin, excision of lateral triangles—Burow’s triangles—and cheek advancement.

![Fig 24](1. Defect lower lip 2. Burow’s triangles to be excised – triangles might be rather large depending on the elastic properties of the cheek skin and only skin needs to be excised to protect the branches of the facial nerve. 3. Cheek advancement flaps 4. Flap incisions along straight black lines (Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission)

2. Loss of Upper Lip Tissue

Partial-thickness defects

These can be managed either by using a skin graft only or a local flap. The graft is taken from the pre- or post-auricular area for color and texture match – these grafts will not contract and the contour of the lip maintained. It will however not grow hair, which can be a problem in the male patient.
Local flaps are usually transposition or naso-labial skin flaps (mostly superiorly based). The naso-labial fold usually has adequate skin and the donor area can be closed directly with the resultant scar well camouflaged in the naso-labial fold – see description under “Reconstruction of the Nose” section.

**Full-thickness defects**

The simplest procedure is a V-excision and repair, but it is less satisfactory and absolutely limited to relative small defects (<1cm) for the reasons of noticeable asymmetry as has been pointed out. Flap repair is therefore often necessary of which the most common is the Abbé flap.

**Less than One Third Loss of Upper Lip**

♦ The Abbé Flap

One-third of the full thickness of the lower lip can be excised without increasing its tightness excessively and this makes the lower lip available for reconstruction of the upper lip. With its structure corresponding almost perfectly to any defect of the upper lip it is ideal for the purpose. The lack of significant anchorage of the lower lip from angle to angle also means that a triangle of lip required for a particular part of the upper lip can be taken with little or no regard to the symmetry of the lower lip.

A useful modification is to design the flap as a “W” (Fig 28) and fitting it into the philtral area of the upper lip with the nostril floor above. A W-defect on the lower lip can be closed as such.

The flap is rotated through 180° and sutured to the upper lip defect. It is very important to make sure that in the pedicle of the flap the feeding labial artery is not caught by the sutures.
The Abbe flap does not include the corner (commissure) of the mouth while the Estlander flap does. They are basically the same except that there is no pedicle that needs to be divided after 2 to 3 weeks as in the Abbe flap.
No pedicle to be divided after 2-3 weeks but often needs a secondary commissure reconstruction (Z-plasty) to correct the round appearance at the angle of the mouth.

(Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission)

More Than One Third Loss of Upper Lip

A combination of local bilateral advancement flaps and lower lip flap (Abbé Flap) is necessary to reconstruct these large defects.

With complete or near complete loss of the upper lip, a distant flap is often the only option.
3. Vermillion Tissue Loss

Vermillion defects smaller than $1\text{cm}^2$ will often close by secondary intention with minimal scarring. Larger defects need repair.

♦ **Mucosal advancement – Vermillion Reconstruction** (Lip Slide)

Mobilization of a mucosal flap from the inner surface of the lip is in the natural and relatively avascular plane between the sub-mucosa and the muscle so that the minor salivary glands of the lip are mobilized with the mucosa. The sutures are evenly spaced along the suture line so that tension is distributed properly braided absorbable 5/0 e.g. Vicryl suture. Partial width defects need cover with the appropriate size flap – these usually need two vertical side release cuts the width of the flap on the intra oral surface.
4. The Angle of the Mouth

Most defects in the region of the angle are actually of one or the other lip which, though they extend to the angle, do not actually involve the other lip. If the angle of the mouth is lost and both upper and lower lips involved, it will demand rather complicated reconstruction to recreate the angle. The best way to approach this is to ignore the angle initially and concentrate on reconstruction of the upper and lower lip separately. Once this is done attention is turned to the angle of the mouth to consider different options depending on the residual defect (this reconstruction is beyond the scope of this chapter but may be found in major plastic surgery texts). A simple z-plasty in the commissure and correct positioning at approximately the mid-pupillary line and also symmetrical to the contralateral commissure will achieve much.

5. Reconstruction of the Cheek

In injuries of the cheek, the underlying structures, which are the facial nerve, facial muscles, parotid duct, and bone, must always be a conscious concern. The facial nerve and parotid duct will be discussed separately later in this chapter.

Most partial thickness defects can be covered by full thickness skin grafts or local flaps. The most useful local flap is the rhomboid (Limberg flap) or modified ‘rhomboid’ flap (defect and flap are designed round instead of as a rhomboid shape which allows one to position the flap anywhere around the defect).
Wound edges cut on periphery and turned in to form intra-oral lining. Defect closed with modified 'rhomboid' flap/round flap from submental area.

In larger defects, a cervical or cervicofacial flap (Mustardé flap) might be necessary (see below). Full thickness defects will need inner ‘mucosal’ lining; a simple split skin graft on the deep surface of the flap is often all that is needed. A defect of 1-2 cm² does not need a graft on the intra-oral surface as it will rapidly re-epithelialize. A platysma flap is an option for mucosal reconstruction. This is a thin myocutaneous flap as seen below in a noma reconstruction (note arrow). The patient had trismus from bony block—mandible to maxilla. A deltopectoral flap was used for cheek reconstruction.
If this flap is used, bone anchors if available should be used to anchor the flap to the zygomatic arch and orbital rim. This flap is used for large cheek defects. The incision extends into the neck. (Courtesy Dr. David Chang)

6. Complex Reconstruction

Cape buffalo injury: Required repair of near complete tongue laceration and ORIF of mandible and MMF

First stage: reconstruction of GSW involved using a platysma turnover flap for mucosal reconstruction, forehead flap for cheek and lip reconstruction (distal end of forehead flap split for both upper and lower lips) and TMJ release bilaterally. Second stage: involved Abbé-Estlander flap for corner of mouth. Fig 55 is soon after second stage (see chapter on Noma reconstruction)
Some injuries are unpredictable such as a gunshot wound or an animal bite. If seen acutely, they can be irrigated and débrided and closed primarily. This was the case with this buffalo injury above.

Gunshot wounds (GSW) are treated initially with irrigation and débridement and delayed primary closure. Often they will be seen for reconstruction years later. Below is a case that was had multiple operations over several years.

II. Reconstruction of the Nose

The nose has a rather prominent position on the face that places it at risk for frequent trauma. If these deformities are not adequately managed at the time of injury, they may result in distorted appearance and/or nasal obstruction from the loss of tissue, misalignment of normal structures, and later from subsequent scarring.

The nose consists of a skin, subcutaneous fat and muscle envelope. The support structure is composed of cartilage (lower third of the nose) and bones (upper two thirds of the nose) that gives the nose its shape. An inner mucosal lining filters particulates and exchanges heat and moisture.

General principles of repair:

- **Partial-thickness defects of the upper two thirds of the nose** (above the sebaceous gland-bearing area) most often only need a full-thickness skin grafts unless large areas of bone or cartilage are exposed.

  - **Fig 56**
  - Full thickness skin graft sutured in position
  - (Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission)

  - **Fig 57**
  - Tied over with a ‘bolus’ dressing

- **Partial-thickness defects of the lower third of the nose** can be reconstructed with a composite graft or resurfaced with local or naso-labial flaps.

  - Composite grafts: for small partial and full thickness defects of the alar rim (see Fig 4 and 5). The donor site is the auricle (Fig 58) and can include fat, cartilage or both depending on the need. The rounded ear rim makes a good graft to reconstruct the rounded alar rim. Composite grafts undergo progressive changes during the process of revascularization. After an initial dead-white color, the
graft turns pale pink due to erythrocyte invasion between 6 and 24 hours. By approximately 24 hours, the graft becomes cyanotic from venous congestion, which gradually disappears over a period of 3-7 days to become a healthy pink color. It is more difficult to observe these changes in darker pigmented skin. For composite grafts to take, the recipient bed must be ideal. In general, any tissue more than 0.5 cm away from the nearest vascular bed will not predictably survive. Therefore, a composite graft used in a full-thickness defect must not exceed 1.0-1.5 cm when the only vascular contact is the periphery of the wound. In reconstructing the alar rim, it helps to enlarge the vascular bed by turning down a flap on the wound margin to be used for nasal mucosal lining and the composite graft can be correspondingly thinner, increasing the surface area in relation to the volume and enhancing vascular contact.

For small full-thickness defects, the naso-labial flaps, banner flaps, and dorsal nasal flaps provide excellent reconstructive material; larger full-thickness defects are best repaired with flaps from the forehead. See Flap Repair of the Nose below. Distant flaps are used only if these are not available.

Flap Repair of the Nose for partial or full thickness defects, lower third and upper two thirds.

The successful relocation of tissue from one body site to another requires adequate blood supply for viability of the flap. Flaps for nasal reconstruction usually come from residual nasal tissue, adjacent cheek, forehead, temporal scalp or distant tissue.

♦ Local Nasal Flaps for Lower Third of Nose. The banner flap is a horizontal triangular flap based at the margin of the defect and rotated into a vertical position. The donor defect is closed directly by advancing the dorsal nasal skin. The mechanism of tissue movement involves standard rotation around a 90° axis to close the donor site along lines of relaxed skin tension. Based ipsi-lateral to the defect, the banner flap suffices for small defects up to 1.2 cm while based on the contralateral side of the nose,
defects measuring 1.5-2.0 cm in diameter may be closed with minimal secondary asymmetry of the nasal tip.

The **dorsal nasal flap** is used to repair larger defects of the nasal dorsum by using the redundant skin in the glabellar area. The flap is based on the angular vessels in the nasolabial fold and consists of downward rotation of the entire skin of the nasal dorsum. Vertical closure in the glabella completes the transfer. The flap gains maximum arc when designed on the contralateral angular vessels sufficient for coverage of defects 1.5-2.0 cm. The dorsal nasal flap is usually based above the alar crease and will not reach the columella without causing secondary distortion of the nasal tip.

♦ **Flaps from the Cheek – The Naso-labial Flap.** The naso-labial tissue is elevated as a subdermal skin flap and can either be utilized as a transposition or advancement flap. Alternatively, it is advanced as a subcutaneous vascular island. Approximately 2.5-3.0 cm of redundant tissue is available in the cheek for reconstructive use in the nose.

It can be based either inferiorly or superiorly; the superior pedicle technique is most useful. The flap may be designed to border the junction of the lateral ala with the cheek, preserving the naso-facial crease. The superiorly based flap is a good method of reconstructing defects of the alar wing and
lateral lobule. When made longer than the distance to the defect, it can be thinned and folded onto itself for nasal lining.

Fig 61
Naso-labial Flap
(Georgiade, Essentials of Plastic, Maxillofacial and Reconstructive Surgery, Lippincott, Williams, and Wilkins. Used by permission)

Fig 62
Full thickness alar defect

Fig 63
Naso-labial flap repair

♦ Flaps from the Forehead for Larger Defects and Upper Two Third Defects

♦ Glabellar Flap - Technique for the Mid-Line Forehead Flap

Fig 64
Glabellar Flap or mid-line forehead flap
(Rob and Smith Operative Surgery—Plastic Surgery, Elsevier. Used by permission.)
The flap is rotated through 180° when it is transferred and care must be taken to ensure that it is sufficiently long to reach its destination without any tension at the pivot point. Flap width can be no more than that which will permit primary forehead closure unless more complicated repair techniques are to be employed - usually not more than 2 cm.

The mid-line flap is carried on either one or both supratrochlear arteries (and distal extension of the angular arteries); these must be protected where they enter the flap in the glabellar area. The superior part of the flap is raised above the periosteum. At the base of the flap in the glabella area, periosteum is taken with the flap for 1-2 cm. above the supraorbital rim to ensure the blood supply is taken with the flap. The base of the flap should be no wider than 1.5 cm. It is rotated into the defect, properly trimmed, and sutured in place with subcutaneous (deep dermal) 5/0 absorbable sutures and 5/0 nylon to approximate skin. The forehead defect is closed directly and in layers.

![Flap rotated and sutured](Fig 65)
![Division of flap and inset at 3 weeks](Fig 66)

The pedicle can be divided at approximately 2-3 weeks after the initial procedure. The proximal margin of the transferred portion is trimmed and sutured in position. The base of the pedicle is trimmed and sutured back into the surgical defect in the glabellar area. See Fig 66. If a large flap is needed, the donor site in the upper forehead may be allowed to close by secondary intention, which works well with little scarring. When repairing or reconstructing large nasal defects, defatting of the flap is carried out 10-14 days after the initial surgery to contour the flap. A week later the flap may be divided.

(Editor’s note: This is also an excellent flap to reconstruct the nasal mucosa. For inner nasal lining, the flap can be turned over so the forehead skin becomes nasal mucosa. Lateral forehead skin based on the contralateral superficial temporal vessels can be used for skin cover.)

♦ Flaps from the Forehead and Temporal Area.

Axially vascularized flaps from the forehead and temporal scalp can be based upon either the supratrochlear or the superficial temporal vessels. In patients with generous foreheads, the flap can be designed in a straight vertical line. For those with low hairlines, obtaining adequate flap length while avoiding hair-bearing skin may be a problem. For this situation, the design has been modified to angle the
flap laterally along the hairline. Greater length may be acquired by extending the pedicle dissection into the glabellar area. It is important to protect the supratrochlear vessels near the base of the pedicle and close to the periosteum. As stated above, the dissection in the glabellar area should be subperiosteal, taking 1-2 cm of periosteum above the supraorbital ridge. Even the angulated flaps can be safely transferred. The vascular pedicle can be later divided and the glabella portion replaced on the forehead.

Procedures that base the flap on the superficial temporal vessels have been designed to avoid central forehead scarring. The upper lateral forehead skin is elevated based on the contralateral superficial temporal vessels, and the scar is essentially hidden by the hairline. Sufficient skin for total nasal coverage may be made available by this technique; the resulting forehead defect usually requires skin grafting. A tissue expander may be used later to expand normal skin so that the skin graft can be removed.

![Fig 67: Forehead Flap based on the supratrochlear vessels](Image)
![Fig 68: Forehead Flap based on the temporal vessels](Image)

(Georgiade, Essentials of Plastic, Maxillofacial and Reconstructive Surgery. Used by permission from Lippincott, Williams, and Wilkins)

![Fig 69: Traumatic nose injury: reconstructed with turnover flaps for nasal lining and forehead flap](Image)
![Fig 70](Image)
![Fig 71](Image)

**III. Reconstruction of the Eyelids**

Effective and early treatment of eyelid injuries is important to preserve the vital functions of the eyelids: protection of the globe, prevention of drying, and appearance.
Repair of full-thickness eyelid lacerations must include repair of the conjunctiva, the tarsal plate, and the skin. The lash line or gray line is used as the guide to ensure proper alignment of the lid margin with the repair. The eyelids are composed of skin, areolar tissue, orbicularis oculi muscle, tarsus, septum orbitale, tarsal (meibomian) glands and conjunctiva. At the lid margin, the conjunctiva meets the skin at the gray line. Embedded within the margins of the lids are the hair follicles of the eyelashes. The tarsal plates support and give form to the eyelids and keep the conjunctiva in apposition to the globe.

The zygomatic branches of the facial nerve (CN VII) innervate the orbicularis oculi muscle for eyelid closure while the oculomotor nerve (CN III) innervates the levator muscle that elevates the upper lid for eyelid opening.

The lacrimal gland is located in the upper outer margin of the orbit and produces tears that flow across the surface of the cornea toward the medial canthus where they enter the superior and inferior puncta. The canaliculus is situated approximately 2 mm perpendicular to the lid margin before turning medially toward the lacrimal sac and naso-lacrimal apparatus, and from there draining into the nose through the inferior meatus.

Eyelids wounds may either be partial thickness or full-thickness and may be with or without tissue loss. Eyelid skin is very elastic, and what may appear to be tissue loss may actually be due to the significant retraction of the wound edges.

The primary purpose for early repair or reconstruction of the deficient eyelid tissue is to provide cover for the sclera and cornea. The cornea is responsible for visual acuity and is very sensitive to drying and abrasion. Normal motion of the upper eyelid is responsible for wetting of the cornea as well as protecting it from trauma.

The lids are also important aesthetically. The eyes are the focal point of the face. The shape of the lid can be seen from a distance while scars are usually visible at conversational distance. It is important to reconstruct the shape and motion of the lid as close to normal as possible.

**Reconstruction of Eyelid Deformities**

♦ **Partial Thickness Injuries**

No tissue loss. Injuries caused by glass or cutting objects may run in any direction.

♦ If the wound lays in the line of the fibers of the underlying orbicularis muscle a continuous 6/0 intradermal monofilament non-absorbable suture may be used.

♦ If the wound lies across the line of the orbicularis fibers there will be retraction of the wound edges and an interrupted 6/0 monofilament non-absorbable sutures should be used to close the skin wound.

♦ If the underlying orbicularis muscle has been cut across its fibers, it must be repaired with interrupted 6/0 absorbable sutures. The skin sutures are removed in 3-5 da
Partial-thickness loss of tissue is best treated by application of a skin graft. When the defect is on or close to the lower lid, in the medial canthal or the lateral canthal regions, or in the pre-tarsal area of the upper lid (the region immediately superficial to the tarsal plate), a full-thickness skin graft should be inserted – post-auricular skin as it is most suitable because of its color, texture and thickness.

Full-thickness skin grafts should be cut to fit the defect so that edge-to-edge apposition is obtained, and there should be no overlapping of graft edges with subsequent necrosis. The graft must put on the stretch leaving the sutures long and ‘over-tying’ them under slight tension across a pad of moist cotton wool—a bolus/stent dressing. These sutures are removed in 5 days, and the graft left open. It is probably wise to suture the upper and lower lid together (temporary tarsorrhaphy) to limit eyelid movement in the first 5 days and to allow suturing of the graft under stretch. Horizontal mattress sutures are placed through the skin and out through the “gray” line on each side and one or two are used.

In the upper lid above the pre-tarsal zone a split-skin is used as split skin is supple and will produce the normal eyelid fold more readily than the full-thickness skin graft.

♦ Full-Thickness Injuries

Full-thickness injuries of the eyelids caused by cutting instruments are usually in an oblique direction because the lids are protected from vertical slashes by the prominent eyebrows and cheeks. The underlying cornea is at risk for damage and should always be carefully examined with a drop of 1 percent fluorescein if available.

The essential requirement in closing a full-thickness wound of the eyelid is to realign the divided tarsal plate. If this alignment is carried out accurately, there will be no deformity of the lid’s margin, but, if it is incorrectly carried out, a deformity will result regardless of the precision of the remaining repair.
The two edges of the tarsal plate and its underlying layer of conjunctiva are carefully approximated using a 6/0 interrupted absorbable suture. A separate 6/0 monofilament non-absorbable suture is inserted exactly in the grey line on each side to give accurate approximation of the margin. The rest of the wound is closed in two layers: the orbicularis oculi (absorbable suture) and skin (monofilament non-absorbable suture). The skin sutures are removed in 3-5 days.

**Canaliculus Damage and Repair**

An attempt must be made at the time of injury to locate the medial divided end of the canaliculus, which usually is identified as a pale structure if normal saline is used to cleanse the wound. A 1 mm silicone tube is passed via the punctum and the peripheral part of the canaliculus into the medial opening and into the lacrimal sac. The tube is sutured along the lid margin, and the conjunctiva is closed with 6/0 absorbable suture. A permanent 5/0 nylon suture is used to approximate the medial end of the tarsal plate to the medial canthal tendon. If this is not done, the powerful action of the orbicularis oculi will drag the lid laterally, and the scar will stretch considerably. The rest of the closure is done as described above. The tube is left in place for 6 weeks, and thereafter gentle weekly probing will help keep the repaired canaliculi patent. At least 60 per cent of these repaired canaliculi will remain patent. Fine gauge silicone tubing and loupe magnification are required to perform this repair. If this equipment is not available, repair should not be attempted. This tubing is commercially available, and is manufactured with a probe attached to both ends that can be passed from both upper and lower canaliculi into lacrimal sac and then down the nasolacrimal duct into the nose. The two ends of the tubing are then tied together so they will not retract. This is the ideal method if the tubing and metal probes are available. This system is called Guibor Canaliculus Intubation Set in the USA.

**Local Flaps in Eyelid Reconstruction for Full-Thickness Injuries**

♦ **The Naso-Labial Flap**

A high, superiorly based naso-labial flap is a versatile and often used method of reconstruction of the lower lid. It may be anchored at the lateral canthus by sutures or bone anchors if available.

The chief disadvantage of the naso-labial flap is that the thick skin gives an abnormal appearance because it lacks the supple and delicate attributes of eyelid skin. When necessary in large defects, however, the naso-labial flap is reliable and easy to use.
The technique involves raising a flap of properly measured size, with care to maintain a relatively thick amount of tissue at the base to preserve the blood supply. The distal portion may be thinned to dermis. The tip of the flap may be anchored into the lateral canthal tendon at its periosteal insertion giving added support. Further defatting may be carried out 6 months later.

♦ **Lateral Cheek or Temporal Skin Flaps**

With full-thickness injuries and tissue loss of the lid margin primary closure should be the goal. Primary closure is possible for defects of up to one-third of the original lid margin, especially in older patients with greater tissue laxity. Closure is performed by placing 6/0 non-absorbable sutures at the gray line, matching up the lid edge. An absorbable suture is used to close the tarsus, which brings the conjunctival edges together. If there is excessive tension, a lateral canthotomy (cantholysis) may provide the necessary relaxation. This is an incision through the lateral angle of the eyelid which divides the lateral canthal tendon and allows mobilization of the lower lid. See below.

An incision is made horizontally from the lateral canthal angle with dissection down to the periosteum of the lateral orbital rim severing the inferior crura of the lateral canthal tendon. The skin is undermined and assessed as to how much cheek skin will be needed. If a small amount of relaxation is needed, then simple undermining and advancement may be done. If a larger amount of skin is needed, then a back-cut may be performed to allow better mobility. This is closed with a Z-plasty. This approach also gives the lateral incision an upward sweep, enhancing the support of the lower lid.

With much larger lid defects, a larger cheek flap (commonly known as a Mustardé flap) may be indicated together with a septal chondro-mucosal graft (Fig 77 and 78 below). Design of the cheek flap is important, with the lateral sweeping incision in the temporal area in a curvilinear manner to the pre-auricular area as far down as the lobule. The level of dissection is in the subcutaneous fat and care must be taken to avoid damage to the branches of the facial nerve that run on the surface of the facial muscles. It is necessary to make a V-shaped cut to complete triangulation of the lower part of the defect to prevent a standing cutaneous cone,
“dog-ear,” from forming. This flap should be anchored to the zygomatic arch and orbital rim to prevent sagging with bone anchors or sutures, preferably wire sutures.

![Fig 77](image1.png) ![Fig 78](image2.png)

**Lateral Cheek Flap (cervicofacial flap) with chondro-mucosal graft**
This taken from one side of the nasal septum, leaving the mucosa intact on the opposite side (See plastic/ENT textbooks or Google the procedure)
(From Georgiade, Essentials of Plastic, Maxillofacial and Reconstructive Surgery. Used by permission from Lippincott, Williams, and Wilkins)

♦ **Glabellar Flap for eyelid reconstruction**

If the previously described techniques are not available, a mid-line glabellar flap or median forehead flap based on the supratrochlear vessels can be used to reconstruct the upper or lower eyelids, or both with a split flap, and also defects in the medial canthal area. The skin in this location is thicker than eyelid skin and should be used only if other procedures are not feasible.

![Fig 79](image3.png) ![Fig 80](image4.png)

**Fig 79**
Complete partial thickness loss of the upper eyelid and loss of eye. Thick **tunneled** glabellar island flap utilized to improve appearance
Lid-Sharing Techniques

Lid-sharing procedures can be utilized to re-construct full thickness eyelid defects very similar to the Abbe flap of the lips.

Dissection of flap

A full thicknesses lower lid flap should be dissected using scalpel and scissors, taking care not to approach closer to the margin in the area of the hinge than 5 mm in order to preserve the comparatively large arcade of marginal vessels running 3 mm from the margin. The defect in the lower lid is closed in three layers. By pulling the base of the lid flap into a position will allow the flap to lie in the upper lid defect without tension on the hinge. The flap is sutured into the upper lid in three layers; conjunctiva, orbicularis muscle and skin. No dressing need be applied. The vascular pedicle can be divided two weeks later and the eyelid margins revised.

Defects of more than half the lid length

Where a defect exists which is greater than half of the width of the eyelid, the secondary defect created will not close directly as it is over a quarter of the normal lid length and the remaining lid tissues will not stretch to this extent. A cheek flap of suitable size is outlined and undermined, as described in lower lid reconstruction (limited Mustardé-like flap).

In very large upper lid reconstructions it will be impossible to locate the lower lid flap on the lateral side of the pedicle because it would encroach on the check. In such cases it should be retained on the medial side of the pedicle hinge.
Two and a half weeks later the pedicle is divided and the lid margins revised. The punctum and canaliculus of the lower lid should be protected in all stages of this procedure.

The Facial Nerve

In wounds of the cheek, damage to the facial nerve is of primary concern and the function of the five different branches must be specifically examined.

The facial nerve exits the stylomastoid foramen. It divides into five main branches within the substance of the parotid gland. The temporal branches run over the mid-section of the zygomatic arch, the buccal branch travels over the masseter along with the parotid duct at the level of a line from the tragus to the center of the upper lip. The mandibular branch runs below the inferior border of the mandible, but not more than 2 cm, and then crosses the mandibular border anterior to the facial artery and vein. The frontal, zygomatic and buccal branches are at particular risk from cheek lacerations. The buccal branches usually have a number of interconnections, and, therefore, a laceration of a single buccal branch may not be clinically apparent. Furthermore, injuries medial to the lateral canthus will almost without exception recover spontaneously.

The function of facial nerve branches should be tested before administration of local anesthetics. Some patients will exhibit asymmetry in facial movement simply
because of pain and edema and it may not be related to any underlying facial nerve injury.

Facial nerve injuries should be primarily repaired. Surgical exploration with loupe magnification (2.5 – 3 x), with good lighting and hemostasis will assist in locating the cut ends of the nerve. A nerve stimulator, if available, can be used to locate the distal nerve segments within 48 hours of injury. After 48 hours, the distal nerve segments will no longer conduct an impulse to the involved facial musculature. If the proximal ends of the facial nerves cannot be located, the uninjured proximal nerve trunk can be located and followed distally to the cut end of the nerve as in a superficial parotidectomy.

The nerves should be repaired primarily with 6-0 to 9-0 nylon using the smallest suture which adequately maintains the nerve coaptation (smallest suture you have available that you can see!) If primary repair is not possible, nerve grafts (sural nerve or postauricular nerves are good donor sources) should be placed, or the proximal and distal nerve ends should be tagged with non-absorbable suture for easy location during later repair. As mentioned primary repair is best and primary nerve grafting is advisable if the patient is stable. Most often one can find local donor nerves for grafting, as the postauricular nerve. (Editor’s note: It is much easier to see and repair the facial nerve acutely or within the first 24 hours.)

The Parotid Gland and Duct

The parotid gland is a single-lobed gland with superficial and deep portions determined by their relation to the facial nerve running between them. The superficial part of the gland is lateral or superficial to the facial nerve and extends anteriorly to the border of the masseter. The parotid duct exits the gland anteriorly and passes over the superficial portion of the masseter, penetrating the buccinator to enter the oral cavity opposite the upper second molar. The course of the parotid duct may be visualized on the external face by locating the middle third of a line drawn from the tragus to the middle of the upper lip. The parotid duct travels adjacent to the buccal branches of the facial nerve. If buccal branch paralysis is noted in conjunction with a cheek laceration, parotid duct injury should be suspected.

If parotid duct injury is suspected, a 22-gauge catheter may be inserted into Stensen duct, and a small quantity of saline or methylene blue solution can be injected. If blue discoloration of the fluid in the wound is noted, the diagnosis of parotid duct injury is confirmed.

Laceration to the substance of the parotid gland without duct injury may result in a sialocele, an accumulation of saliva, but will rarely cause any long-term problems. If a gland injury is suspected, the overlying soft tissue should be repaired and a drain left in place. If a sialocele develops, serial aspirations and a pressure dressing should be sufficient to resolve the problem.
Three operative techniques have been debated: repair of the duct over a stent, ligation of the duct, and fistulization of the duct into the oral cavity.

The facial wound is often extensive enough to allow adequate visualization of the structures and their repair but further exploration of the parotid gland and duct might be necessary.

The most important initial step is the identification of the buccal branches of the facial nerve and the parotid duct itself. If the buccal branch was transected, repair it with a 6-0 to 9/0 nylon suture and with magnification if available.

Repair of the parotid duct is done over a silastic stent with interrupted sutures using loupe or microscopic magnification. The duct is sutured into the cheek mucosa near the papilla with non-absorbable suture, ideally a non-absorbable braided suture as silk. See below.

The distal end of the parotid duct is identified by the silastic tube, which was placed in the Stensen’s duct via the intraoral papilla. The proximal parotid duct can usually be identified by the flow of saliva into the wound.

If the duct is injured near the papilla but the papilla is uninjured, the proximal parotid duct may be dissected free and reimplanted into the papilla. The papilla may be gently dilated if this technique is chosen. If the papilla is injured or if the proximal end of the duct does not reach the papilla, the duct may then be reimplanted into the oral mucosa posterior to the papilla. This should be performed under loupe magnification with fine interrupted 6-0 to 8/0 absorbable sutures. Again a stent should be used and anchored to the cheek mucosa with a non-absorbable suture. If the length of the proximal duct is insufficient to be reimplanted into the oral mucosa without undue tension, then it is best to ligate the proximal duct.

Injuries occurring over the masseter muscle are the most common cause of injuries to the parotid duct and may be treated by repair or ligation. Primary repair should be attempted if enough length remains. Cut the edges cleanly and perform anastomosis over the silastic stent. (In sharp lacerations, the duct ends only need simple cleaning prior to repair.) A single layer repair with interrupted 6-0 to 8-0 nylon sutures is used under loupe magnification. If a portion of the duct
Injuries of the proximal duct near the parotid substance are usually best treated by ligation of the duct. Laceration of the gland itself without disruption of the parotid duct may be oversewn with fine absorbable sutures (5-0 or 6-0 Vicryl).

If a repair of the duct is done over a stent, the stent is trimmed at the level of the oral papilla and sewn to the oral mucosa or around the maxillary second molar with a non-absorbable braided suture. This is designed to hold the stent in place for the recommended 2-3 weeks while the injured duct heals and to help prevent stenosis at the repair site. A non-absorbable braided suture is preferred since the patient's tongue continually rubs against the suture and may loosen or dislodge it especially if it is a chromic suture or even a Prolene suture.

The remaining facial and intraoral lacerations, as well as any incisions required for exposure, are then closed in the standard fashion.

**Human and Animal bites**

Human bites of the face are serious injuries. Not only is the potential for infection always present, but these wounds may result in gross disfigurement. The main objectives in the management are prevention of infection and functional closure of the wound with the best possible cosmetic result.

Human bites of the lip are potentially heavily contaminated, but primary closure of such wounds under antibiotic coverage (amoxicillin clavulanate - Augmentin) is recommended for early recovery and best possible aesthetic outcome. Early flap design permits primary closure of many wounds.

The excellent blood supply of the face, the use of antibiotics, and early surgical repair make infection of human bites of the face a rare occurrence, even when patients seek help at a relatively late stage.

Many studies show low rates of infection in early repair under antibiotic coverage. It is a safe procedure with all the advantages of short hospital stay, low morbidity, and good cosmetic results.

Wounds should be thoroughly irrigated with a povidone iodine solution and good surgical debridement achieved without sacrificing tissue unnecessarily. This is followed by primary closure. Where primary closure is not possible because tissue has been avulsed, the defects are closed immediately with various skin flaps or Wolfe grafts—full thickness skin grafts. The aim should be to do a definitive single-stage procedure or, where this is not possible, to commence with the first stage of a reconstructive procedure, e.g. Abbe rotation flap or post-auricular advancement flap.

When patients present late with wounds and signs of infection, i.e. cellulitis, erythema and tenderness, it is recommended that necessary débridement of the wound and aggressive antibiotic treatment is given. Once the cellulitis has settled and the infection is under control, the wound edges should be excised, creating a new, clean wound for closure. This requires 2-3 mm of tissue to be removed from
all the edges. The wound edges are closed directly or local flaps are used for closure.