Reconstruction of oncologic defects of the eyelid, lips and ear

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ABSTRACT

Non melanomatous skin cancers constitute a major part of the cancers that occur in the face, especially in the darker skinned people. Surgical excision stays as the main modality of treatment in these giving very good cure rates. The major drawback of surgery is the resultant functional and esthetic deformity, which has been considerably reduced with proper application of reconstructive surgery principles. In order to achieve good outcome attention has to be given to understand the anatomy as well as tissue requirement at specific areas of the face. There is a great variation in the reconstructive methods in the different sites. This article reviews briefly the anatomy and methods of reconstruction available for the post cancer excisions involving the lips, eyelids and the auricle.

KEY WORDS

Eyelid reconstruction, reconstruction of ear, reconstruction of lips

Non-melanomatous malignant cutaneous neoplasms comprise a third of all cancers diagnosed globally.[1] The World Health Organization reports a rising incidence mostly due to a depleting ozone layer. Predisposing factors include phenotype, genetic syndromes, precursor lesions and immunologic variables. Environmental factors include exposure to ultraviolet radiation, ionizing radiation, chemicals, smoking, chronic skin irritation and ulcerations.[2] Basal cell carcinomas and squamous cell carcinomas comprise the majority of these tumours. Their biologic behaviour is also quite variable; some have a relatively benign course and others progress to extreme morbidity, mutilation, metastasis and death.

Surgical excision with a margin is the mainstay of treatment with cure rates of 90 to 95%. Mohs' techniques have been used to achieve even higher cure rates, particularly in specialized areas of the face.[3] The role of the plastic surgeon is essential in the treatment of this disease, especially when larger tumours are present. Though some of these lesions can be removed and closed directly with acceptable cosmetic and functional outcome, use of full thickness grafts or local flaps like bilobed flaps, rhomboid flaps give a better result in others. The reconstruction is easier with the lesions present in areas of the face like cheek, nasal skin and forehead. But when areas like eyelids and lips are affected more ingenuity needs to be applied in the reconstruction. Discussion of reconstructive techniques after cancer excision of the entire face will be too exhaustive, hence we will restrict this review to discussing some of the options in the reconstruction of post ablative defects in the special areas of the face like eyelids, lips and ear.

LIP RECONSTRUCTION

The lips are the primary central aesthetic unit of the lower face. Reconstruction of the lips involves providing a natural appearing, yet dynamic reconstruction that provides functional mobility.

Anatomy and function

The lip is composed of four essential structures that are necessary for a successful reconstruction: the skin and subcutaneous tissue, muscle, vermillion and mucosa. The lip skin is of intermediate thickness for facial skin and is rich in sebaceous and sweat glands. Deep to this layer is the subcutaneous fat, which provides lip bulk and thickness. The external landmarks are the philtral columns and Cupid's bow. The philtral columns diverge slightly as they course from the base of the columella to the vermillion border. These philtral columns merge with the white roll. Orbicularis fibres form a dimple between the two columns, known as Cupid's bow. The primary muscle of the lip is the orbicularis oris. These are paired horizontally oriented muscles that originate lateral to the comissure at the modiolus. In the upper lip, the muscle inserts into the opposite philtral column. It also sends fibres to the nasal ala, sill and septum providing oral competence. In the lower lip, the orbicularis oris joins in the midline. The buccal branch of the facial nerve innervates it. The second most important lip muscle is the mentalis. It is the main elevator of the lower lip allowing for lower lip positioning and lip competence. It is a large trapezoidal shaped muscle that originates from the mandible just below the attached gingival and inserts horizontally and inferiorly into the chin pad below the labiomental fold. The marginal mandibular branch of the facial nerve innervates the mentalis muscle. The depressors of the lip include the depressor anguli oris, the depressor labii inferioris and platysma.

The inside of the lip is lined by mucosa. It is distinct from the vermillion in colour and appearance. The vermillion which is the visible portion of the lip inside the white roll, is more dull in appearance than the mucosa.

The lip serves many functions as a result of its unique sphincteric muscle anatomy. This allows for oral competence with eating and drinking, speech and sound production, forceful blowing and kissing. Therefore, lip reconstruction can be frustrating and complex, because lip tissues may look fine at rest, but function being abnormal in the living, moving patient.

LIP DEFECTS

When analyzing a lip defect, the amount of remaining vermillion is the most important assessment. If present, the vermillion carries muscle that will retain the sphincter function of the lip. Next, one must decide whether the lip can be reconstructed with lip tissue, which is preferable or will require non-lip tissue. Replacing "like with like" allows the orbicularis muscle to eventually have some element of neurotization and a functional reconstruction. Direct lip closure or closure with sliding lip tissue is always the first choice. Lip switch procedures, such as the Abbe[4] and reverse Abbe flap,[5] also satisfy this principle of "lip with lip." They do not move the commissure and the insertion of the orbicularis into the modiolus is preserved. This allows for a more normal dynamic appearance. They also tighten the donor lip, providing balance to the tightened reconstructed lip. Other lip defects require sliding lip tissue around the commissure, such as the Estlander,[5] Gilles[6] and Karapandzic flap.[7] They do not require a secondary division and inset. Some defects are too large to reconstruct with lip tissue. If a defect involves greater than 40% of the total available upper and lower lip area or when on a single lip is more than 80% of its width, reconstruction using remaining lip tissue will result in microstomia. Hence, reconstruction of new lip tissue with non-lip tissue is necessary, such as the Webster-Bernard,[8-10] McGregor,[11] Nakajima[12,13] and free flap reconstructions. Establishing lip competence and a natural dynamic appearance is more difficult with non-lip tissue.

VERMILLION

Alignment of the vermillion is a key element in any lip procedure, from simple lacerations to complex reconstructions with flaps. Step offs of 1mm are noticeable at conversation distance. It is imperative to identify and mark the vermillion or white roll prior to injection of local anaesthetic. A needle dipped in methylene blue is recommended along with nerve blocks to minimize direct tissue infiltration. Tissue eversion is essential to prevent visible notching or depressions. Small superficial defects can be closed primarily without flap elevation. If necessary, V-to-Y advancements from inside the vermillion can be used to provide additional tissue.

For large vermillion defects that do not involve the white roll, flaps are indicated. These include vermillion flaps[14-16] and tongue flaps.[17,18] Vermillion flaps are best for defects close to the white roll. Techniques include vermillion advancement or vermillion switch flaps from the opposite lip. Advancement flaps work best for central defects. They have a robust blood supply based on the labial vessel and the normal vermillion taper is preserved. The external incision is made directly on the vermillion border and the intra-oral incision made well inside the lip. This advantage is lost in lateral defects. For lateral defects, the distance from the vermillion border to the wet-dry line is measured on both sides of the defect. The taller side is then tailored such that there is minimal step off between the vermillion and wet-dry line.

For a vermilion switch flap, the vermilion is cut the same as an advancement flap, but inset into the opposite lip. The donor lip is then reconstructed with an advancement flap at flap division, 10 days later.

Non-lip flaps, such as the tongue flap, provide another method of reconstruction. The anteriorly based lateral tongue flap, which does not use papillary tongue, provides significant bulk, but an unnatural appearance. Therefore, it is reserved for lateral defects. It is important to avoid the papillary tongue and to use meticulous closure of the tongue to avoid exposure of the lingual nerve.

Upper lip

Superficial or partial thickness defects can often be closed primarily. It is important to ensure orbicularis oris muscle closure to provide optimal lip function. For a larger central or lateral defect, a full thickness graft from the preauricular area is a reasonable option. This technique can provide hair growth, enhancing the aesthetic appearance.

Full thickness defects up to one-third can be closed primarily with local tissue rearrangement or advancements [Figure 1a, b]. This will often include perialar crescentic excisions and medial advancement of the nasolabial fold.

For central full thickness defects involving up to half the distance between the philtral columns, primary closure is the best option. For defects greater than half the central lip, an Abbe flap will give the best result, however, the remainder of the central lip should be excised.

The Abbe flap[4] is based on the labial artery and harvested from the central lower lip. For central upper defects, it is elevated to the labiomental fold. For lateral defects, it continues through the chin pad. It is inset above the columella base with extensions to the nasal sill. The flap is divided and inset at two weeks.

This flap can be utilized for lateral defects as long as the comissure is intact. It is best to combine the flap with a perialar excision and lip advancement. Hence the flap is inset at the alar base and cheek tissue can be advanced to fill the lateral portion of the defect.

For even larger defects, the Abbe flap is simply made larger. It is designed with a bilateral Schuchar advancement[19] (described below) to allow medial advancement of the lower lip and closure of the large donor defect. This will result in microstomia and require secondary lip stretching. Remember, it is necessary to balance the length of the upper and lower lip.

Total upper lip loss is rare and requires non-lip tissue to reconstruct. This results in an unnatural appearance at rest and in the living moving patient. Most of these patients have lived with large deforming tumours for years prior to seeking care. Functional reconstruction in the upper lip is not as essential as the lower lip. The radial forearm is a useful flap for subtotal or total lip defects.[20-22] It can provide intraoral and external tissue. The vermillion can be reconstructed with tattooing or buccal mucosa grafting.

Lower lip

Defects are divided into central lip or those approaching the comissure. The lower lip can tolerate primary closure

Figure 1a: Full thickness excision marked for a lesion in upper lip

Figure 1b: Post operative result after full thickness excision and direct closure

for the majority of defects. Superficial defects less than 50% can be closed primarily, whereas for those greater than 50% a skin graft is appropriate.

The Schuchardt procedure is appropriate when primary closure is not possible. This is a sliding lip reconstruction that advances the lower lip with an inferior incision along the labiomental fold to the mandibular border. Intraorally, incisions are made on the labial side of the gingivo buccal sulcus. This procedure can be applied to most lower lip defects and combined with the lip switch procedures.

The workhorse of the lip-switch procedures is the reverse-Abbe flap,[5] which can be used for lateral or central defects. The lateral reverse Abbe flap is based on the medial labial artery. It differs from the Estlander flap in that it does not move the comissure. The lateral aspect of the flap and thus the vermillion, is kept medial enough, so it is of sufficient height to match the medial defect of the lower lip. The tip of the flap is the perialar crescentic excision to allow primary closure of the upper lip. This is useful for lateral defects that cannot be repaired by the Schuchardt technique alone.

The central reverse Abbe flap is used for central lower lip defects. It differs from the lateral reverse Abbe flap in that perialar crescents are discarded and blood supply is lateral. This flap can also be performed as a double central reverse Abbe flap for large lower lip defects. Precise measurement is necessary to maintain evenly distributed tissue between the upper and lower lip.

The sliding lower lip flaps are the Karapandzic[7] and Estlander flap.[5] The Karapandzic flap essentially has a design similar to the Gilles flap but maintains the nerve supply to the lower lip. It is a rotational advancement flap along the nasolabial fold that pivots at the comissure and upper lip. The Estlander is a lip-switching flap that involves the comissure and pivots the upper lip to the lower lip. Bilateral Karapandzic flaps can be employed to cover defects up to 80%. Although the lip is innervated, there is often microstomia, rounding of the comissure and misplacement of the modiolus.

For larger defects, non-lip tissue utilization techniques will need to be adopted. The Webster Bernard flap involves the medial advancement of cheek tissue to create a new lower lip. It is necessary to excise tissue from the nasolabial fold to allow this advancement. The vermillion can then be recreated using bipedicled sliding mucosal flaps. A free radial forearm flap can also be used for the lower lip. The palmaris tendon can help suspend the lower lip, allowing for better oral competence [Figure 2].

Post-reconstruction

It is often preferable to accept some degree of microstomia over reconstruction using non-lip tissues. This can be treated with serial stretching. Self-retaining dental retractors are easy to obtain and use. Hair transplantation can also be helpful in camouflaging scars and restoring normal appearance.[23,24]

EYELID RECONSTRUCTION

Reconstruction of the eyelid is based on providing protection and integrity of the underlying globe. Accurate assessment of the anatomic defect and available tissue is necessary to ensure proper restoration of anatomic relationships, preserve function and achieve an aesthetic pleasing result.

The upper lid provides 90% of palpebral closure producing most of the corneal coverage. Lid function is directly related to the amount of orbicularis oculi or levator muscle loss. The orbicularis oculi provides the pumping action to propel tears out of the palpebral aperture preventing them from overriding the lid margin. Failure to preserve this mechanism can result in epiphora. The lower lid moves superiorly only 1-2 mm, lubricating the inferior pole of the cornea.

Eyelid anatomy

The upper lid margin measures approximately 30mm in

Figure 2: Total lower lip reconstruction using a free RFF and palmaris sling

horizontal length. There are three to four rows of cilia directed away from the ocular surface. There are three lamella that compose the eyelid. The anterior lamella is composed of skin and orbicularis muscle. The middle lamella of the upper lid is composed of orbital septum, orbital fat and the levator complex. The posterior lamella is composed of the tarsal plate, Muller's muscle and the conjunctiva. The tarsal plate measures approximately 10mm in vertical height.

The lower lid is similar in anatomy measuring approximately 30mm in horizontal length. There is only one row of cilia. The anterior lamella is composed of skin and muscle. The middle lamella has the orbital septum, orbital fat and capsulo- palpebral fascia. The posterior lamella is composed of the tarsal plate, lower lid retractors and conjunctiva. The tarsus of the lower lids measures approximately 4-5 mm in vertical height.

The posterior lamella is a non keratinized surface of conjunctiva and can be replaced by surrounding conjunctiva or buccal, gingival or hard palate mucosa. The tarsal plate can be replaced with free tarsal grafts or hard palate mucosa. For free tarsal grafts from the upper lid, it is important to leave 3-4 mm of tarsus to maintain stability. The middle lamella is reconstructed with soft tissue, but it is rarely functional or mobile. The anterior lamella can be reconstructed with skin from surrounding areas. If the defect is too large, a full thickness skin graft is preferable.

Reconstruction of post ablative defects

Partial thickness defects

For partial thickness defects, there is an occasional role for non surgical management. Allowing the wound to granulate and heal is possible for small defects if the posterior lamella is intact. Colobomas or lid retraction will result if full thickness defects are allowed to heal by secondary intention. Even if the anterior and middle lamella heals, the posterior lamella defect can cause a foreign body sensation or trichiasis. Satisfactory results with secondary healing can be anticipated with medial canthal defects. However, punctual eversion can be expected with defects encroaching on the punctum.

For partial thickness defects requiring surgical management, the nature of the surrounding soft tissues is important in choosing the method of reconstruction. In older individuals and patients with anterior lamellar laxity, it is possible to recruit adjacent tissue to close the defect primarily or perform a local myocutaneous advancement flap. If there is no excess skin, the anterior and middle lamella can be reconstructed with a full thickness skin graft. Donor sites that match the eyelid skin are superior lid fold, the posterior auricular region or the supraclavicular skin. More extensive defects may require cheek or forehead rotational or advancement flaps.

Full thickness defects

Defects less than one-fourth in both the upper and lower lid can often be easily reapproximated. For those between one-fourth to one-third, a lateral cantholysis often is necessary for primary closure without tension. Three anatomic points are primarily sutured with 6-0 silk to re establish anatomic boundaries; the meibomian gland orifices, the lash line and the grey line or mucocutaneous junction. The sutures are cut long and tied away from the surface of the eye. Next, the edges of the tarsal plate are repaired with 6-0 chromic sutures making sure not to pass through the conjunctiva avoiding corneal abrasion. Then the anterior lamellar tissues can be closed with interrupted or running 6-0 silk sutures. If the eyelid closure is tight, a lateral canthal release is required. A new canthal angle can then be created with absorbable sutures and one permanent suture at the desired lateral angle between the upper and lower lid. A canthopexy suture may be necessary to support the lateral segment of the eyelid.

Full thickness defects between a third and two-thirds require an advancement flap, which is best accomplished with the Tenzel flap (semicircular advancement flap).[25-28] A lateral inferiorly directed semicircular incision is used for the lower lid and a superiorly lateral-based semicircular flap is used for upper lid reconstruction [Figures 3a, b]. Either a superior or inferior cantholysis is performed for upper or lower lid reconstruction, respectively. After wide undermining, the lateral lid tissue can meet the nasal edge of the defect. The lid margin is realigned and lateral canthus is reconstructed with 4-0 PDS suture to plicate the orbicularis muscle of the flap to the periosteum of the lateral orbital rim. Incision is closed with 6-0 permanent sutures.

Full thickness defects greater than two-thirds require lid-sharing flaps. The Cutler Beard Bridge Flap[29,30] is used to reconstruct large full thickness defects of the upper lid. The flap is designed below the level of the marginal arcade of the lower lid to avoid ischemia of the remaining

Figure 3a: Defect in middle third of upper eyelid

Figure 3b: Post operative result after a Tenzel flap advancement

bridge of the lower lid skin. The incision is placed 4-5 mm below the lower lid margin. Flap tension is relieved by two parallel vertical full thickness incisions deep into the inferior fornix. The flap is then passed beneath the remaining bridge of the lower lid margin and advanced superiorly to fill the upper lid defect. The advanced conjunctiva is sutured to the upper lid conjunctiva. The skin and muscle are then reapproximated. The flap is divided six to eight weeks later by making a horizontal incision 2 mm lower than the desired lower lid margin to account for contraction. Also, the flap can be bevelled, allowing a longer conjunctival side reducing the contact of keratinized epithelium with the surface of the eye.

Full thickness defects greater than two-thirds of the lower lid also require lid-sharing flaps. The tarsoconjunctival or Hughes flap[31] is the procedure of choice for large defects of the lower lid. Using a Desmarre's retractor, the upper lid is everted; 4 mm of tarsus is left undisturbed and a horizontal incision is placed along the tarsus and orbicularis to the extent of tissue required to fill the defect. Dissection is carried out between the tarsus and orbicularis up to the upper border of the tarsus. The dissection plane is then made between Muller's muscle and the conjunctiva. It is important to maintain Muller's muscle, as loss can lead to retraction of the upper lid after division of the flap. After the flap is elevated significantly into the superior fornix to grant laxity, the flap is advanced inferiorly to fill the lower lid defect. The flap is then sutured to the remaining tarsal edges of the lower lid. If none exists, the lateral tarsal margins are sutured to the inner periosteum of the lateral orbital rim. Medially, the flap can be sutured to a remnant of canthal tendon.

Full thickness loss of the entire lower lid necessitates reconstruction of both the anterior and posterior lamella using tissue imported from elsewhere. For the posterior lamella a composite graft of nasal septal cartilage with the mucosa and for the anterior lamella a rotation flap from the adjacent area provides satisfactory results.

Postsurgical care

Corticosteroid and antibiotic combination eye drops and analgesic medications are used for the first postoperative week. Skin sutures are removed at one week, lid margin sutures are removed at two weeks. Eyelid-sharing flaps are divided at four to six weeks.

EAR RECONSTRUCTION

Anatomy

The ear has a characteristic shape with prominences and recesses. A balance of thin skin covering a cartilaginous foundation creates this ear structure. The skin of the anterior ear is thin with minimal reticular dermis. For this reason, incisions heal with minimal scarring. It is tightly adherent to the underlying cartilage with little subcutaneous tissue. The skin of the posterior surface of the ear is thicker, with more reticular dermis. It has more mobility than the anterior ear skin and thicker subcutaneous tissue. It also has minimal propensity for scarring, though slightly greater than the anterior skin.

Cancer defects are most commonly on the superior helix of the ear and the lobule is generally spared. Depending on the size and location of the defect, partial ear reconstruction is usually performed with one the following: excision of ear and primary closure, reconstruction with ear flaps and cartilaginous reconstruction.

Principles

Local ear flaps will give the most natural appearing ear with perfect match of skin quality and texture along with a flexible, normal feeling ear. Any reconstruction with flaps or excision will result in a smaller ear. They will also tend to make the ear more prominent. Significant defects are best managed with a two-staged technique of cartilage reconstruction using the posterior ear skin and subsequent elevation.[32-35] For defects less than a quarter of the ear involving only the rim and scapha, the scapha and helix or the lobule can be treated with the use of conchal cartilage for replacing the lost cartilage.[36] For defects greater than one-fourth of the ear, rib cartilage[37] is needed.

Treatment

Excision of the ear is useful for many defects. The main principle of this technique is reduction of the ear in all dimensions so that the form is maintained even though with a reduction in overall size of the ear.

Ear flaps are most useful for reconstructions of helical rim defects. The Antia-Buch method[38] of mobilization of the rim and advancement will close defects up to 1.5 cm. Defects up to 3 cm can be closed by a combination of the Antia-Buch and excision.

For larger defects, local flaps will not give a normal appearing result. Likewise, excision and closure will leave a ear that is too small and is not recommended. These defects should therefore be reconstructed with cartilage framework and retroauricular skin. For defects up to one quarter of the ears' size that involve only two planes of the ear, conchal cartilage[36] will suffice. A plane of the ear corresponds with the height and depths of the ear. For example, the helical rim is a high point and constitutes a plane. The depth of the scapha is the next plane of the ear. Therefore, a defect of the helical rim and scapha would constitute two planes. If the defect extends to the antihelix that would constitute a third plane, while the depth of the concha constitutes a fourth plane. The curve of the contralateral conchal graft will replace two planes. The typical right angle at the posterior wall/conchal floor is what allows this two-plane replacement. Unlike rib cartilage that easily will make a multilayered construct, the conchal cartilage cannot be manipulated to replace three planes.

For defects requiring rib frameworks, the framework generally replaces the missing structure.[37] Occasionally,

Figure 4a: Post traumatic loss of entire pinna

Figure 4b: Cartilage framework fabricated

Figure 4c: Post operative result after covering the framework with superficial temporal facia and skin graft

remaining native ear cartilage is excised in order to allow for a smooth union of the native ear cartilage and the framework. This is seen with excision of a portion of the helical rim with extension of the helical portion of the framework in the upper third resections. When the whole ear is to be replaced and skin is not available the cartilage framework can be wrapped up in temporalis facia which in turn is covered with skin graft. The ultimate quality and colour match for the skin may be less than desired, but the gross effects of the missing ear especially in a male patient can be mitigated to some extent [Figures 4 a-c].

For some patients, tissue reconstruction is not a viable option. In others, prior attempts at reconstruction leave no local tissue for reconstruction and preclude an acceptable result. Patients may be older and not willing to undergo the procedure or are not candidates for multiple staged procedures. These patients may be candidates for prosthetic reconstruction.[39,40] Osseointegrated implants[41] may be of use in these situations.

CONCLUSION

Performing post ablative reconstruction on the eyelids, lips and ear, though challenging, is quite rewarding for both the patient and the surgeon. These highly visible and functional structures are significant and their restoration can make the difference between a morbid cure and a successful cure from cancer.

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