Cheek and inferior eyelid reconstruction after skin cancer ablation

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The cheek is the largest aesthetic unit of the face, with an underlying bony frame and an overlying soft central part. Its outlines are different in each person, due to changes with age, skeletal shape, and thickness of adipose and muscular tissue. The perception of the cheek varies depending on the angle from which it is viewed. Menick\cite{1} noted that it is impossible to compare its symmetry to the contralateral cheek unit from a single view.

The characteristics of the cheek, such as laxity and low rigidity, allow for the use of a wide variety of local and regional flaps for reconstruction. Its close relation to the inferior eyelid constitutes a challenge, because alterations resulting from cheek reconstruction may impact the function and symmetry of the eyelid.

Etiology and epidemiology

A change from normal to neoplastic tissue is caused by a variety of etiologic factors such as physical agents, activation of cancer-promoting genes, viruses, inhibition of cancer-suppression genes, and chemicals\cite{2}. Skin cancer has been linked to arsenic and ultraviolet radiation exposure. Skin types I and II are most susceptible to actinic damage and neoplastic changes. White people living in countries close to the equator or in subtropical zones are most susceptible to developing squamous cell and basal cell carcinomas\cite{3}.

Other factors associated with skin cancer are those structural changes at the cutaneous sebaceous layer where excessive free fatty acids and obstruction of the pilosebaceous unit allow for chronic inflammatory folliculitis. Alterations in the immune system, especially those in IgA, macrophages, white cells, and Langerhans’ cells, play an important role in carcinogenesis and may have a genetic component\cite{4}.

According to the Colombian National Cancer Institute report for the year 2001\cite{5}, skin cancer is the third most common neoplastic lesion after cancer of the cervix and breast. Nonmelanomas represent 8.7% of skin cancers; among these, basal cell carcinomas account for 53.4%, whereas squamous cell carcinomas represent 31.4%\cite{5}.

In tropical climates such as in Colombia, intense sunlight can be felt during most of the day throughout the year. Louisiana is a subtropical region, but it has a very high percentage of sunny days. Like Colombia, Louisiana has a large population that participates in outdoor employment or recreation. In Colombia, the proximity of areas of deep forests such as the Amazon, the Pacific, the Darien, and the Orinoquia are thought to be a protective factor against damage to the ozone layer and therefore against skin cancer. Other protective aspects are the wide range of ethnic groups among which there is a high incidence of people with dark skin, which is essentially an adaptive resistance to ultraviolet rays. Diets rich in beta-carot-
tene [6], tomatoes [7], fruits, vegetables [8], and fish [9] also are believed to be protective factors against skin cancer.

Despite the previous considerations, people older than 50 years of age with a history of extensive occupational sunlight exposure compose a high percentage of actinic lesions and skin cancer in our patients. Most of these patients are agricultural, fisheries, open field, or offshore workers who have an average of 10 hours of daily solar exposure. Smoking also has been implicated in about 5% of the skin cancer cases and usually is associated with perioral squamous cell carcinoma.

**Anatomic considerations**

The peripheral boundaries of the cheek are formed by hard and soft tissues. Superiorly, the lower eyelid and the superior margin of the malar and zygomatic arch form the limit. Medially, the border is formed by the nasolabial and mesolabial fold and is supported by the maxillary bone. Inferiorly, the mandibular contour line and jowls form the frame. The lateral edge is the preauricular crease and the posterior rim of the mandible.

The anatomic layers of the cheek as described by Gonzalez-Ulloa [10] include the skin, a homogeneous layer of fascio-adipose tissue, and the superficial musculo-aponeurotic system [11]. These layers are interconnected by a system of ligaments. Between the periosteum and dermis are four layers of mimetic muscles: one superficial, two intermediate, and one deep layer [12]. The masseter muscle, the buccal fat pad, the facial nerve, the parotid gland, and Warthin’s duct lie deep to the mimetic muscles. The osseous structures that anchor the ligaments are the anteroinferior border of the zygomatic arch, the inferior orbital rim, and the inferior border of the mandible. Branches of the external carotid artery perfuse the cheek. The venous system drains to the jugular veins. The terminal branches of the facial nerve supply the motor innervation. The branches of the trigeminal nerve provide the sensory innervation.

The elasticity of the cheek results from its soft structure supported by facial attachments such as the great zygomatic ligament, the anterior platysmal-cutaneous ligament, the platysma, the auricular ligaments, and the mandibular ligaments [13]. The skin of the medial and buccal subunit of the cheek is thick and mobile. The skin of the zygomatic subunit is attached firmly to the deep layer of soft tissue. The lateral subunit is related closely to the fascia of the parotid gland (Fig. 1).
The following layers compose the inferior eyelid: skin, areolar tissue, muscle, tarsal plate, septum orbitalis, fat, and conjunctiva. The skin is thin and elastic. The orbicular muscle—which is divided into pretarsal, preseptal, and orbital portions—is part of the transition zone between the eyelid and the cheek. For the purpose of planning cheek reconstruction, Larrabee [14] divided the cheek into four subunits: the medial, zygomatic, buccal, and lateral cheek subunits (see Fig. 1).

Principles of treatment

Many patients diagnosed with nonmelanoma skin cancer have noticed the presence of the lesion within the year before presentation. Patients frequently delay seeking medical help and often treat the lesion with antibiotic ointment or home remedies. Additionally, as in Louisiana, social or economic issues may prevent patients from seeking treatment. Advanced lesions demand special attention and require meticulous his-

Fig. 4. Case 1. (A–E) Advancement flap closure of medial cheek defect.
topathologic mapping to ensure clear margins. If complex reconstruction is required, closure should be delayed until margins are confirmed. Once a complete resection of the lesion in both radial extension and depth is confirmed, a plan for an anatomic reconstruction is formulated. The outcome of each alternative is considered and the best option is determined for each case.

Successful treatment depends on adequate planning and a multidisciplinary approach. Whenever possible, the reconstructive surgeon should participate in the whole surgical process, including the ablation of the tumor and the repair of the defect. The ablation and reconstruction should be considered together to gain every advantage, because each case presents different challenges. When formulating a plan in cheek and related inferior eyelid surgery, options for reconstruction should be formulated before ablation. Dividing the cheek into anatomic subunits is useful to determine the type of closure to be used. Crossing over the anatomic subunits of the cheek does not constitute a limitation for an aesthetic repair, as it does for the more central units of the face such as the nose, lips, and eyelids. The plan should take into consideration the size, depth, and location of the defect as well as the timing and possible complications of the surgery.

Medial area

In the medial area of the cheek the subcutaneous fat allows for easy mobility of the attached skin, and
Defects that constitute up to 25% of the subunit may be closed directly at the cheek–nose junction and mesolabial fold (Fig. 2). Because the medial cheek subunit becomes increasingly narrow as it abuts the nose and there are inalterable boundaries (lower eyelid, nose, and nasolabial fold), local flaps such as rhomboid, bipedicle, or transposition flaps are difficult to use. Alternatively, advancement flaps may be used (Fig. 3). Deep permanent or long-lasting absorbable sutures from the dermis of the flap should be fixed to the periosteum of the nasal bone or pyriform aperture to avoid distortion of the cheek–nose junction. Defects that involve between 25% and 50% of the medial cheek are closed with advancement flaps elevated in the plane deep to the subdermal plexus.

Deep sutures must be placed to the periosteum of the pyriform aperture to prevent distortion of the nasofacial groove or the overlying lower lid unit. We have used anchor fixation devices to ensure flap support [Case 1 (Fig. 4A–E)]. Defects that involve 50% to 75% of the subunit are closed with cheek rotation-advancement flaps (Fig. 5). If the defect involves the medial canthus, a paramedian forehead flap is useful [Case 2 (Fig. 6A–C)].

Defects that involve the entire medial subunit, border the inferior eyelid, and involve the medial or lateral canthus are best treated with cervicofacial flaps (Fig. 7) [Case 3 (Fig. 8A–F)]. These large flaps supply enough tissue and allow for a reasonably tension-free closure of the donor site. Jackson and Webster [15] suggest de-epithelializing and concealing the resulting dog-ears, which will increase the projection of the flap. Anchoring the flap to the periosteum...
Fig. 8 (continued).
of the zygomatic arch or malar bone and the use of drains is recommended.

**Lateral area**

Repairing the lateral and adjacent areas of the cheek follows principles similar to those described above for the medial area. Defects located in the preauricular region that involve up to 50% of the lateral subunit may be repaired with direct closure (see Fig. 2). If a smaller defect is located inferiorly or medially, especially if it encroaches on the buccal or zygomatic area, options include a rhomboid flap or a V-Y advancement flap (Fig. 9) [Cases 4 (Fig. 10A, B) and 5 (Fig. 11A, B)]. When using a rhomboid flap, the flap should be planned so that the closure of the donor site is along the axis of maximum tissue laxity. It also is important to choose the design so that the donor closure does not leave a scar anterior to the defect, encroaching on the central face. This scar will be visible from the frontal view and should be avoided. V-Y advancement flaps should be closed along subunit borders or along minimal skin tension lines [16–19].

Defects involving greater than 50% of the lateral subunit are treated with extended direct closure, retroauricular transposition flaps [Case 6 (Fig. 12A–C)], or cervical rotation flaps (Fig. 13). Total lateral defects that also involve the buccal or zygomatic subunits typically require a cervicofacial flap [Case 7 (Fig. 14A–C)]. Whenever possible, the final incisions

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Fig. 9. V-Y and rhomboid flaps for cheek repair.

Fig. 10. Case 4. (A, B) Rhomboid flap for lateral defect.
Fig. 11. Case 5. (A, B) V-Y advancement flap for lateral defect.
Fig. 12. Case 6. (A–C) Retroarticular transposition flap.
Fig. 13. Larger lesions require more inferior flap development.

Fig. 14. Case 7. (A–C) Cervicofacial rotation flap for extensive defect.
should be placed along the unit borders or should follow Langer’s lines of minimal skin tension.

**Zygomatic area**

Defects that are smaller than 30% of the zygomatic subunit can be repaired by direct closure (see Fig. 2). Transposition flaps can be used when the tissue deficit is between 30% and 70% of the subunit. Defects that involve more than 70% of the zygomatic subunit may require cheek rotation advancement flaps (Fig. 15) [Case 8 (Fig. 16A–D)]. To prevent inferior flap displacement and ectropion, anchoring sutures should be placed lateral to the orbit and the flap should be designed with a high lateral arch above the canthal plane. Special attention must be given to the temporal branch of the facial nerve, which runs at the subdermal layer in this area.

**Buccal area**

Depending on the skin laxity, defects of up to 30% are repaired by direct closure or a transposition flap. Defects that involve 30% to 70% of the buccal subunit will require transposition or cheek advancement flaps [Cases 9 (Fig. 17A–C) and 10 (Fig. 18A–D)]. Defects of more than 70% of the subunit will require a cervicofacial flap for repair [20,21]. This area is unique because the central area does not have any underlying bony support. Deeply invasive lesions in this area may require oral lining as well as soft tissue bulk. When this occurs, free flaps are a good reconstructive option [Case 11 (Fig. 19A–E)].

**Inferior eyelid**

Eyelid reconstruction depends on the size and position of the defect as well as the quality of surrounding tissue. The main purpose of eyelid restoration is to supply anatomic and functional protection of the ocular globe with good support, mucosal lining, and an appropriate skin cover. Whenever possible, it is important to safeguard the structures providing lacrimal drainage. Reconstruction of the cheek must not distort the anatomy of the lower eyelid.

Partial defects of any of the lamellas may be closed directly or by using local flaps or grafts. Full-thickness defects are more complex. Full-thickness defects that are smaller than 30% of the eyelid may be repaired by direct closure [Case 12 (Fig. 20A–D)]. Defects of the anterior lamella that involve greater than 30% of the eyelid may be repaired with regional flaps such as Tripier’s or Fricke’s flaps. Resection of the total lid should be repaired with a facial rotation flap such as the Mustarde flap [Case 13 (Fig. 21A–F)] [22]. Despite its random blood supply, this flap is reliable and provides good...
Fig. 16. Case 8. (A–D) Cheek rotation flap for defect resulting from ablation of malignant tumor involving facial nerve.
Fig. 17. Case 9. (A–C) Transposition flap for buccal subunit defect.
Fig. 18. Case 10. (A–D) Cheek advancement flap for buccal subunit.
Fig. 19. Case 11. (A–E) Free scapular flap, folded and de-epithialized to form lining and cheek resurfacing.
Fig. 19 (continued).
Fig. 20. Case 12. (A–D) Twenty-five percent full-thickness lid resection closed.
Fig. 21. Case 13. (A–F) Subtotal lower lid reconstruction with nasal septal chondro-mucosal graft and Mustarde flap.
color match and easy donor site closure, especially in the elderly.

Small defects of the posterior lamella can be closed directly. Larger defects must be repaired using conjunctival, oral, or nasal mucosal grafts supported with either septal or conchal cartilage with the mucoperichondrium. A tarsal-conjunctival flap of the superior eyelid also may be used to repair the posterior lamella. At least 4 mm of the superior eyelid tarsal plate must be preserved to maintain its integrity and function.

Summary

Most patients with actinic lesions and skin cancer are skin type I or II, older than 50 years of age, and have a history of extensive sunlight exposure. These patients have been treated in our units according to universal principles. A multidisciplinary team approach can produce encouraging long-term results. The size and depth of the lesion are assessed in planning the ablation. The residual defect after the tumor resection is anticipated in the preoperative plan. Adequate resection is mandatory, even if the reconstruction must be delayed to ensure clear margins.

Attention to unit and subunit anatomy facilitates adequate reconstruction with acceptable deformity. Placing scars in borders or along the lines of minimal skin tension reduces deformity. Planning the flap so that the donor site is in tissue areas with maximum laxity guards against donor site deformity. Flaps must be planned to avoid excess tension on the lower lid and central face. Attempts should be made to reduce scarring in the central face as seen in the frontal view. Respecting these principles will allow for reconstruction of the largest facial unit in a manner acceptable to the patient.

References