Lip reconstruction after ablation for skin malignancies

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Many operative procedures have been described for lip reconstruction following resection of skin cancer. This article describes a conceptual approach to lip reconstruction that restores both form and function. Lip reconstruction is commonly required following resection of malignant neoplasms. The skin and vermilion are primary sites for 12% of head and neck cutaneous lesions [1]. Smoking, alcohol consumption, and actinic injury are predisposing factors.

Anatomy and function of the lips

The primary function of the lips is oral competence. They have a remarkable ability to distinguish liquid from solid. Combined with the muscles of mastication and the dental apparatus, the lips are essential for mastication. Speech, emotional expression, musical expression, and musical performance are impaired without normal lip function.

The lip is a tri-laminar structure composed of mucosal lining, orbicularis oris muscle, skin, and vermilion. The mental nerve provides sensory innervation of the lower lip. The upper lip sensation is provided by the infraorbital, nasopalatine, and nasociliary nerves. Sensation is crucial for lip competence and the prevention of drooling.

Two sphincters, oriented at right angles, function synchronously to ensure labial competence. The buccinator and deep orbicularis oris form an axial sphincter that seals the lips against the teeth and closes the gingio-labial sulcus. The superficial orbicularis acts as a coronal sphincter, purse stringing and pouting the lip. Movement in the facial plane is made possible by complex positioning musculature (Fig. 1).

Many facial muscles also are used to position the lips. The zygomaticus major and minor, levator labii superioris, and risorius elevate the lips; and the platysma, depressor labii inferioris, depressor anguli oris, and mentalis act as depressors. Most facial muscles insert into a fibromuscular confluence (modulus) of the orbicularis, buccinator, and positioning muscles at the lateral pole of the orbicularis.

The upper lip may be divided into three aesthetic units. The junction of aesthetic units is called a border. The central lobule is bordered by the philtral ridges. The Cupid’s bow forms the inferior border and the base of the columella is the superior border. Two rhomboids extend from the phyltral border to the nasolabial (melolabial) fold, creating the lateral aesthetic units. The superior border is the nasal sill and alar base above and the inferior border is the vermilion. Minimal skin tension lines (MSTLs) are oriented vertically in the central lip.

The lower lip can be divided into two aesthetic subunits, again rhomboids. They meet in the midline and are bordered inferiorly by the chin, laterally by the labial mental folds, and superiorly by the vermilion border, which is usually less distinct than its counter-
part on the upper lip. The vermilion gradually thins and becomes indistinct at the commissures (Fig. 2).

**Using anatomy to plan lip reconstruction**

Several principles should be followed during the planning phase of lip reconstruction, to allow for aesthetic and functional reconstruction to be achieved consistently. During reconstruction, it is ideal to maintain innervation of the sphincters. Procedures that preserve the integrity of the muscles preserve function. Smith [2], however, demonstrated electromyographic reinnervation of transplanted muscle after cross-lip flaps. Fibrillations were noted as early as 24 hours and single polyphasic motor unit potentials were produced with voluntary effort by 6 months. The amplitudes of these motor unit potentials continued to increase and at 1 year were similar to those of normal labial muscles. Clinically, at 12 months following surgery, pain, touch, and sweating were considered nearly normal. The muscle is transposed into the sphincter defect during this procedure. Nonetheless, respect for the sphincter should be a part of preoperative planning.

![Fig. 1. The axial and coronal sphincters and the positioning muscles of the lips.](image1)

![Fig. 2. Topographic anatomy and borders of the lips.](image2)

![Fig. 3. Pentagonal excisions. Vermilion excess trimmed. Scars lie in MSTLS and tension is away from the lip margin.](image3)

![Fig. 4. Crescent excision and cheek advancement flap, Nasolabial transposition flap.](image4)
It also is important, when possible, to protect the sensibility of the lips during reconstruction. Insensate lips cannot distinguish between solids and liquids and drooling results. The topographic anatomy of the lip should be considered when planning the reconstruction. Scars that lie along borders of the lip or in MSTLs are favorable. Reconstruction of an aesthetic unit should be undertaken when necessary, to avoid a “patched” appearance.

Reconstruction of skin defects

Small skin defects should be repaired with techniques similar to those used during reconstruction of other areas of the face. Incisions should be placed in MSTLs or borders. If the skin cannot be closed under reasonable tension, well-designed flaps will prevent distortion.

We favor the “pentagonal” technique for resections of up 1.0 cm. Wedge resections may result in inadequate margins at the lower portion of the resection and produce the greatest tension at the lip margin [1]. “Dog-ears” that occur at the vermillion can be corrected with excision or Z-plasty. The resulting scars lie in the MSTLs (Fig. 3). Smaller lesions involving the mucocutaneous junction can be repaired with a pentagonal skin excision, a V-Y vermilion advancement, or a mucosal V-Y advancement [1,3].

Skin defects of the upper lip exceeding 1.5 cm

Defects that exceed 1.5 cm can be closed with an advancement flap from the cheek, using a crescent excision around the ala and a Burrow’s triangle at the commissure. This crescent peri-alar cheek advancement, described by Webster [4], can be used for repair of partial- or full-thickness upper lip defects (Fig. 4). Crescent-shaped peri-alar cheek tissue either is excised completely or is embodied in the advancing flaps and closure is made in the alar–cheek border. The cheek flap is anchored at the alae by heavy buried sutures.
either to the periosteum or to the fibrous tissue of the alae, so that the weight of the cheek will not displace the nostril. The nasolabial fold will reform at its anatomic location as healing occurs.

Nasolabial tissue can be used to resurface the lip. The nasolabial flap provides excellent color and texture match. Blood supply is based on perforating branches of the terminal angular artery. This flap can be as large as 3 cm × 10 cm [5], but the flap width should equal or exceed length to prevent “balling up” of the flap. The nasolabial fold will reform at its anatomic location as healing occurs (Figs. 4–8).

Excision of the phyltrum causes significant topographic distortion. Occasionally in males, the phyltral

Fig. 6. (A) Partial thickness defect following basal cell resection. (B) Thinned nasolabial flap rotated into defect. (C) Result with no revisions. Scars lie in border or MSTLs.
Fig. 7. (A) Wide partial thickness resection for squamous cell carcinoma. (B) Cheek advancement flap with perialar crescent resection. (C) Result prior to scar revision. Distortion may have been less with bilateral flaps.
Fig. 8. (A) Squamous cell carcinoma, partial thickness resection. (B) Superior based nasolabial flap. Width exceeds length to reduce tendency for flap to roll up. (C) Final result. Scars lie in borders or MSTLs.
Fig. 9. (A) Partial thickness vermilion cutaneous defect. (B) Opposing V-Y advancement flap. (C) Result—note that vermilion has excess advancement because it moves much more easily than cutaneous flap.
Fig. 10. Abbe’ flap for central full-thickness defect.

Fig. 12. Burget reconstruction of lateral full-thickness subunit defect.

Fig. 11. (A) Thin melanoma, resection to include 2/3rds of philtrum. (B) Abbe’ flap to reconstruct philtrum, cheek advancement flap for lateral lip. (C) Final result without revision. Scars lie in borders or MSTLs.
Fig. 13. (A) Full thickness defect from extensive basal cell carcinoma. Repair with cross lip flap. (B) Result at 4 months. Scars lie in borders or in MSTLs. (C) Note innervations of transposed muscle.
ridges are indistinct and removal of the phyltrum does not cause distortion. In women or patients with sharp, defined ridges, a “skin-only” cross-lip flap or a full-thickness graft between the phyltral ridges can reconstruct the phyltral aesthetic unit. Lesions that require resection of vermilion and skin may be reconstructed by a V-Y skin advancement combined with a V-Y mucosal advancement (Fig. 9). In all of these flaps, the resulting scars are in MSTLs or borders.

The V-Y skin flap is advanced, with the underlying orbicularis providing blood supply. A V-Y mucosal flap from the labial sulcus reforms the vermilion. Lip form is not compromised with this technique and tissue is used in the reconstruction that would have been discarded in a wedge excision [6]. If the labial mucosa is advanced directly [7,8], inversion of the lower lip, chronic irritation, and unnatural appearance may result [9].

Premalignant and benign lesions limited to the vermilion may be treated with vermilionectomy and reconstruction with a vermilion advancement flap. Treatment of thickened, irreversible leukoplakia of the lip vermilion is the most common indication, but others include chronic solar keratosis, actinic cheilitis, radiation ulcers, cutaneous horns, and in situ or non-invasive carcinoma of the lip vermilion (Bowen’s disease) [10]. Reconstruction can be accomplished with a vermilion advancement flap, although this procedure may produce a red lip, displaced beard in the vermilion cutaneous junction, and a lack of lip pout. Modifications of the procedure include depilation of 2 mm of the skin adjacent to the new lip to reduce the presence of beard, a source of potential irritation [6]. Including muscle in the advancement [7] and creating a V-Y vermilion advancement are two other modifications.

Smaller excisions of upper lip vermilion may be closed with vermilion-opposing advancement V-Y flaps, but excisions of more than 1.5 cm usually requires a vermilion flap. Goldstein [11] described repair of a defect of approximately one-half of the vermilion using a single arterialized vermilion flap. For reconstruction of a central defect larger than one half, bilateral vermilion flaps have been described [12]. The lower lip may be resurfaced with vermilion advancement, and the lower lip vermilion may be transferred to the upper lip as a cross-lip flap for deficits in the upper lip. This technique uses the overabundant and protruding lower lip as a donor site to augment the deficient upper lip, and has yielded good results in many instances [13]. A cross-lip vermilion flap also has been described with its pedicle based laterally at the commissure, which avoids the necessity of mouth closure before pedicle division in the uncooperative patient [14].

**Full-thickness resection of the upper lip**

Defects of up to a quarter of the upper lip lateral to the phyltral ridges may be closed primarily without much distortion. If the patient has a sharp phyltral aesthetic unit and the defect involves the phyltrum itself, a cross-lip Abbe’ flap produces a more satisfactory result than advancing the lateral lip into the aesthetic unit (Figs. 10 and 11). The Abbe’ flap [15,16] may be used to partially fill a medium-sized defect,

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**Fig. 14.** Total upper lip reconstruction with Webster technique.

**Fig. 15.** Pentagonal excision and nasolabial flap for skin defects of lower lip.
thereby converting it into a small defect. Lateral lip advancement with peri-alar crescent excision can close the defect lateral to the philtrum. The use of the Abbe’ flap is limited to defects that do not involve the commissure in cooperative patients who will accept lip adhesion for 14 days. In males who do not have phyltral definition, lateral segment advancement may be simpler and not excessively deforming.

Defects greater than one fourth of the upper lip require the addition of tissue. Following the principles of Burget and Menick [17], an aesthetic unit reconstruction of the lateral subunit (phyltral column, nostril sill, alar base, and nasolabial crease) with a medially based cross-lip flap can yield an aesthetically excellent result (Figs. 12 and 13). These authors believe that the lower lip is the only tissue that is suitable for upper lip repair and that an entire subunit should be replaced if a large portion has been lost, rather than patching the defect. The scars will thus fall along natural borders and the commissure will be symmetric. It is important to form a template on the unoperated side and transfer the template to the lower lip. It also is important to take as much mucosa as skin in the cross-lip flap, to avoid cicatrix in the mucosal closure. The muscle transferred in the flap usual becomes innervated within 4 to 6 months (see below) [2].

Loss of greater than three quarters of the upper lip requires more than the tissue available from the lower lip. In such cases, cheek advancement flaps with crescent excision at the alar bases can gain significant lip length, and the center segment can be reconstructed with a cross-lip flap, laterally based. First described by Blasius [18] in 1840 and modified by Webster [4] in 1954, this procedure now bears his name and is called Webster’s combination procedure. This procedure produces an overly large central segment, but still stays within the general aesthetic unit borders and provides innervated muscle in the flaps (Fig. 14).

**Reconstruction of lower lip skin defects**

Skin defects of the lower lip can be resurfaced in a similar but inverted fashion to that of the upper lip, using pentagonal, rotational flap from the labial–jugal area (Figs. 15 and 16). Up to one third of the lower lip can be excised and closed without creating ste-
Fig. 19. (A) Squamous cell carcinoma of lower lip. (B) Almost total resection with marking for Webster’s modification of Bernard-Borrow’s repair. (C) Resection (D) Immediate result. (E) Final result demonstrating oral competence. Scars lie in borders.

Fig. 18. (A) Recurrent squamous cell carcinoma lower lip. (B) Unilateral Webster flap, note that there is central defect due to re-resection of central chin/lip. (C, D) Abbe’ flap added to reconstruction for central vertical defect. (E, F) Result with no stenosis, lines are in borders or MSTLs.
nosis, especially in older patients. Excising more than one third of the lower lip will cause stenosis, making it impossible for patients to insert dentures or eat bulky foods.

Although there are many procedures for defects that exceed one third of the lower lip, such as the Karapandzic [19] the Webster-modified Bernard procedure [20] is very reliable. It provides sensate skin, innervated muscle, and mucosal coverage and leaves scars in the aesthetic unit border. The flap can be used as a bilateral advancement for total lip reconstructions or as a unilateral advancement for defects that are one third to one half of the lower lip (Figs. 17–19). Webster modified the Bernard-Burow procedure [21] by excising only skin in the discarded triangles, rather than skin, muscle, and mucosa. Using Webster’s modification, Madden et al [22] were able to preserve the innervation of the orbicularis and leave the positioning muscles intact, providing a superior functional result for the sphincter. Webster’s modification provides sensate skin, innervated muscle, and mucosal coverage and leaves scars in the aesthetic unit border [23].

The oral commissure

The oral commissure is a particularly vexing problem. It is anatomically complex both in function and

Fig. 20. Modification of Estlander flap for commissure defect.

Fig. 21. (A) Squamous cell carcinoma lower lip, tiny remnant of commissure preserved. (B) Estlander flap planned with crescent reduction of peri-chin tissue. (C) Flap in position. (D) Immediate post operative result, prior to procedure to re-establish commissure. (E) Final result. Scars lie in borders or MSTLs.
appearance. The Estlander flap [24], ingenious as it is, always blunts or rounds the commissure when the commissure is completely resected. In general, if only the upper lip or lower lip commissure is involved, reconstructing the lip by advancing cheek tissue with mucosal flaps should provide a relatively sharp commissure. Rather than robbing from the anatomically more complex upper lip, we prefer to reverse the flap and harvest it from the lower lip (Fig. 20).

If the Estlander flap is employed with a segment of preserved commissure, a secondary procedure is required to release the commissure (Fig. 21). If a segment of both upper and lower lip are resected and the resected width exceeds one third of the lower lip, additional tissue must be added to avoid stenosis or, conversely, the stenosis will have to be dealt with at a second procedure.

Massive defects involving the lips may require free transfer for closure. Large lower lip and chin defects have been reconstructed with the radial forearm free flap [25,26] with good results, but a supporting structure (tendon or fascia) is needed to support the reconstructed lip (Figs. 22 and 23).

Fig. 21 (continued).

Fig. 22. (A) Massive recurrent basal cell carcinoma requiring radical maxillectomy and lip resection. (B) Closed with deep inferior epigastric perforator free transfer to fill orbit, lip, and palate. Result not aesthetic, but patient has reasonable function.
Fig. 23. (A) Recurrent squamous cell carcinoma of lip invading bone. (B) Free radial osteocutaneous forearm flap harvested. (C) Flap inset, skin island used for resurfacing. (D) Oral competence compromised by lack of support. (E) Karapandzie revision provides competence.
Summary

When performing lip reconstruction following resection of skin cancer, it is important to plan the reconstruction to retain sphincter function and to design the flaps so that resulting scars fall into borders or MSLTs. These reliable and logical approaches to lip reconstruction will help to restore both form and function.

References