Oral commissure reconstruction with orbicularis oris elastic musculomucosal flaps

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KEYWORDS
Elastic flap; Oral commissure; Reconstruction; Vermilion

Summary
Surgical reconstruction of the oral commissure aims to restore both symmetry of the lips at rest and, more importantly, full oral competence. Moulding the lip commissure with functional and cosmetic fidelity remains till today a difficult task.

A possible surgical solution, the 'elastic flap' principle described by Goldstein, may be found in the wide full-thickness mobilization of the upper and lower vermilion as two composite myocutaneous flaps — tissue sandwiches consisting of labial skin, orbicularis oris muscle and oral mucosa — on the axial pattern of the superior and inferior labial arteries. Based on the contralateral commissure, both flaps are easily 'stretched', accordion-like, to reach the predetermined point of the new commissure, using to full advantage the inherent elastic potential of both vermilions. The fibres of the orbicularis oris muscle at each end of both flaps are embricated to reconstitute a neo-modiolus, which is anchored to the residual buccinator muscle in primary reconstructions, or to the available peri-oral fibrous tissue in secondary procedures.

The authors present a select group of 22 patients, who, between 1993 and 2008, underwent this reconstruction procedure for primary or secondary defects involving the oral commissure. The results were generally satisfactory, both functionally and cosmetically.

The advantages of this procedure include full restoration of the dynamic function of the orbicularis ring in a single-stage operation and avoidance of either lip-switching procedures or of mobilization of mucosa and cheek skin. The final scars remain well camouflaged within the oral mucosa and the mucocutaneous junction of each lip.

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Restoration of a full-thickness defect that includes the oral commissure presents a considerable challenge to the reconstructive surgeon.

Although burn contractures and congenital defects may be the common causes, malignancy involving the
commissure, as well as varying portions of the lower and/or upper lip, is the most frequently encountered clinical situation.\textsuperscript{1} Carcinoma of the lower lip, in fact, accounts for approximately 12% of all head and neck tumours, as well as for 25% of cancers of the oral cavity.\textsuperscript{2} Squamous cell carcinoma is the most frequently occurring tumour in this area;\textsuperscript{3} the recommended safety excision margins are at least 1 cm from the visible borders of the lesion, so reconstruction becomes mandatory even for small tumours.\textsuperscript{4} The technical difficulty is obviously greater for lesions involving the commissure than for the same-sized defects of the lip proper.

The aims of surgical reconstruction of the oral commissure are both functional and cosmetic. The functional aims include restoring oral competence and adequate articulation, both, achieved through the re-establishment of a functioning (i.e., adequately reinnervated) orbicularis oris muscle ring.\textsuperscript{5} The cosmetic aims include restoring symmetry of the lips in repose and when animated, with an adequate stomal diameter, as well as avoidance of conspicuous scars as far as possible.

A possible one-stage surgical solution, the ‘elastic flap’ principle as described by Goldstein, may find application in the restoration of the oral commissure.\textsuperscript{6} This entails a wide, full-thickness mobilization of both upper and lower vermillion as two composite myocutaneous flaps based on the healthy contralateral commissure and fully advanced to reconstitute a ‘neo-miodolus’. Such flaps can be viewed as tissue sandwiches consisting of labial skin, orbicularis oris muscle and oral mucosa, based on the axial pattern of the superior and inferior labial arteries.

The authors describe their experience of reconstruction of lower lip defects involving the oral commissure on 22 consecutive cases using a one-staged method of repair based on the original technique described by Goldstein for vermilion defects.\textsuperscript{7,8}

### Patients and methods

From January 1993 to February 2008, within the Department of Plastic and Reconstructive Surgery, Ospedali Riuniti di Bergamo, a series of 22 consecutive patients underwent reconstruction of oral commissure defects with upper and lower vermilion advancement musculomucosal flaps (Table 1). Of the 22 patients, 17 were male and five female, of an average age of 63 (32–82) years.

All the defects involved oral commissure with varying portions of the lower and/or upper lip(s). While two were post-gunshot and another subsequent to excision of a haemangioma, all the other reconstructive procedures followed excision of squamous cell carcinomas (n = 19).

Primary reconstruction was carried out in 18 cases, while secondary reconstruction was performed in four patients.

<table>
<thead>
<tr>
<th>Patient No.</th>
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<th>Defect Site</th>
<th>Associated Procedures</th>
<th>Follow-Up (months)</th>
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<td>Left Oral Commissure</td>
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<td>Double V-Y advancement flaps</td>
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<td>32</td>
<td>Facial Gunshot</td>
<td>Left Oral Commissure</td>
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</tr>
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M, male; F, female; SCC, squamous cell carcinoma; HM, haemangioma.
Oral commissure reconstruction with orbicularis oris elastic musculomucosal flaps

One of the latter patients underwent cheek and commissure revision after primary reconstruction with a radial forearm free flap, while a second patient underwent revision after a previously performed Estlander flap.

In two patients, the authors’ technique was described to restore a gunshot wound with a residual incompetent commissure. In three cases, reconstruction by means of upper and lower vermilion advancement musculomucosal flaps was also associated with Y-Y advancement flaps elevated from the adjacent cheek or other flaps.

Fifteen (68%) procedures involved the right commissure, while seven (32%) involved the left. Of the 22 patients, 12 wore dentures.

Follow-up period ranged from 3 months to over 5 years (average: 17.5 months).

Anatomy

Each lip is a three-layered structure composed of skin, muscle and mucosa. The vermilion is the most visible element of both upper and lower lips; its reconstruction is thus indeed exquisitely delicate, as even minor defects may lead to severe blemish.1 The underlying musculature is prevalently defined by the orbicularis oris muscle, which provides the sphincteric function and oral competence. The muscle originates bilaterally at the modiolus, where it blends well with the cheek muscles at the corner of the mouth. Then, the prevalently horizontally orientated fibres of the orbicularis are inserted in a more vertical fashion at the commissure. Prevalently horizontally orientated fibres entering the muscle radially, originating from the ‘nave of the wheel’, with muscles converging into it as ‘radiating spokes’.11

Other associated muscles include the zygomaticus major and minor, levator anguli oris, levator labii superioris, depressor anguli oris, depressor labii inferioris, risorius, buccinator, mentalis and platysma muscles. Though anatomically important, such muscles can indeed be transected without really affecting the all-important sphincteric action of the orbicularis oris muscle.12,13

The oral commissure is where the orbicularis oris fibres from the upper and lower lips interdigitate, and where the vermilion is pulled laterally inwards to the modiolus.

Motor innervation is segmental for each lip, with motor fibres entering the muscle radially, originating from the buccal fibres of the facial nerve for the upper lip and from the marginal mandibular branch of the facial nerve for the lower lip. Sensory innervation stems from the infra-orbital nerve for the upper lip and the mental branches for the lower lip.13 Lymphatic drainage is through the submental and submandibular lymph nodes.13

Blood supply to the lips is via the superior and inferior labial arteries from the facial artery, with venous drainage from the accompanying veins.13 Both labial arteries, entering each lip in a radial fashion, run between the mucosa and the orbicularis musculature at approximately the border between the white and red mucosa, and run circumferentially along the oral rim, Anastomosing with their contralateral counterparts in the middle of the lip. This unique vascular pattern allows an impressively wide mobilization of the orbicularis oris muscle with no risk for its vascularity.

Operative technique

Preoperatively, the position of the neo-commissure is planned by measuring the distance from a point in the middle of philtral columns to the commissure on the unaffected side. This measurement is then transposed by calipers to the affected side with a hypercorrection of 5–10 mm in primary reconstruction. In secondary cases, such hypercorrection is unnecessary since the neo-miodolus would be fixed to the pre-existing fibrotic scar.

Full-thickness resection of the lesion or of the scarred commissural area is then performed under general anaesthesia with nasal intubation. In cases of primary resection for a squamous cell carcinoma, the lesion should be excised with ample free margins under loupe magnification, leaving approximately 1 cm of the healthy tissue around the tumour.1

An incision is then carefully carried out along the white roll of both the lips, up to 1 cm of the contralateral oral commissure, exposing the orbicularis oris muscle along its whole length. Of course, if the defect involves different portions of the upper or lower lip, an incision of this length on the unaffected lip would be unnecessary.

A wavy pattern of incision initiated with a no. 11 blade under loupe magnification and then followed by cautery dissection using a micro-needle (Colorado, Stryker Cranio-maxillofacial, Portage, MI, USA) will allow a better cosmetic outcome by better blending with the finely irregular mucocutaneous junction (Figure 1).

After cutting through the skin, subcutaneous tissue and vermilion orbicularis muscle, the cautery needle is turned obliquely upwards at the upper lip and obliquely downwards at the lower lip in order to prevent any inadvertent injury to the labial arteries. The mucosa is then finnally transected as needed, usually along all the length of the incision, although it may be at times possible to spare some mucosa close to the base of the flaps, and simply stretch it to some degree. It is also advisable to try to preserve and re-orient as far as possible the visible nerve branches in their radial, segmental distribution to each of the

Figure 1 Wavy incision at the mucocutaneous junction.
vermilion. Some of such branches can be distinctively appreciated and stretched, rather than transected, similar to the Karapandzic flap procedure, unless they actually hinder the full advancement of the flaps. To this purpose, the cautery needle is better replaced by blunt, fine-tipped, tenotomy scissors dissection after entering the orbicularis muscle.

At the end of the dissection, two musculomucosal flaps which include the entire thickness of the vermilion, the subjacent orbicularis oris muscle and all or most of the underlying mucosa are obtained. Raised on the contralateral commissure, they represent true arterialized myocutaneous flaps based on the axial pattern of the superior and inferior labial arteries.

Then, the flaps, cut free from their anchors to the adjacent tissue, are easily ‘stretched’, accordion-like, to reach the predetermined point of the new commissure, thus using to full advantage the inherent elastic potential of both vermilions (Figure 2). The fibres of the orbicularis oris muscle at each end of both flaps are embricated to reconstitute a neo-miodolus, thus restoring the dynamic function of the orbicularis ring, and re-establishing full oral competence. Oblique tapering of the ends of both flaps finally assures a gentle flow of the red lip as it disappears, terminating at the new commissure. The neo-miodolus is anchored to residual buccinator muscle in primary reconstructions, or to the available peri-oral fibrous tissue in secondary procedures.

A functional primary reconstruction necessarily requires some initial degree of lateral and cranial traction of the neo-miodolus. Since some inevitable retraction will occur due to both the scar and the contralateral, initially unopposed, dynamic muscle pull, in addition to the 0.5-cm hypercorrection already mentioned, the authors in their more recent cases support the newly built angle of the mouth by a simple non-absorbable 2/0 nylon spanning suture under appropriate tension. This suture is initiated from the point of embrication of the myomucosal flaps up to the tragus, in a tight, appropriate, subcutaneous tunnel (Figure 3). It is our impression that such suture will help keep the position of the neo-commissure in the time gap needed for the muscle to regain its function.

Closure is performed in layers with absorbable sutures, restoring the mucocutaneous junction, muscular sphincter and mucosa. A layer of antibiotic ointment serves as a final dressing. A nasogastric tube is preferred for a few days postoperatively in order to avoid suture contamination.

At times, the defect resulting from excision of a squamous cell carcinoma will be so large as to require additional local flaps. These flaps are usually V-Y flaps from the cheek, which, once advanced, will then limit the remaining area to be re-surfaced to the exact fit required by the tapered lip musculomucosal advancement flaps.

**Results**

All the flaps healed uneventfully, and no revision was carried out in any of the cases. Even when some form of touch-up was suggested by the operating surgeon, such proposal was uniformly rejected by the patients, who considered their result satisfactory. The final scars remained well camouflaged at the mucocutaneous junction of each lip and were practically almost invisible.

All reconstructed commissures remain competent and of adequate shape and dimensions at follow-ups from 8 to 67 months.

In some instances, some moderate fault at symmetry was observed; in fact, while microstomia never occurred, there were some instances of modest asymmetry in the position of the reconstructed commissure as compared to the normal side. This was either an excess of vermilion height of either lips, with loss of the natural tapering effect (which occurred when the area to be re-surfaced was somewhat greater than that provided by the joined advancement flaps, thus causing mucosal eversion and stretch and, retrospectively, the local flaps from the cheek should have been added; Figure 4a and b) or an excess of lateral displacement of the neo-commissure, due to lateral hypercorrection (which occurred when the anticipated medial scar retraction was overestimated; Figure 5a and b).

As mentioned, these patients, possibly because of their age group, refused proposed revisions.

All patients were able to resume a soft diet and then progress to normal diet 10 days after the operation.
repetitive stretching of the vermilion flaps through speech, feeding and manual massage allowed a quick rehabilitation in all cases. No drooling of food or saliva was noticed in any of the cases at follow-up.

No recurrence of the resected tumours has been observed in any case so far.

Discussion

The oral commissure is a notoriously difficult area to reconstruct: the goals of reconstruction are not only restoration of oral competence with adequate sphincteric function for speech and food retention, but also appropriate aesthetics and contralateral symmetry.

Re-establishment of this functional integrity, because of its complexity, brought Bakamjian in 1964 to define this surgical endevour as an ‘almost unreachable objective.’\textsuperscript{14}

The literature is replete with a discussion of various methods: Converse\textsuperscript{15} suggests using as donor tissues, in descending order of preference, the remaining lip segment,\textsuperscript{16–18} the tongue,\textsuperscript{19} the adjacent cheek,\textsuperscript{20,21} or even distant sites.\textsuperscript{22–24}

The present authors’ method is a one-stage repair of vermilion defects based on the surgical technique originally described by Goldstein.\textsuperscript{6} In 1984, Goldstein proposed a vermilion advancement flap to repair defects up to approximately one-half of the length of the lip. The significant innovation of this procedure consisted in the concept of an orbicularis oris musculomucosal flap based on the labial artery, which could be pulled, accordion-like, employing the inherent ‘elastic’ potential of the vermilion itself. This elastic flap is in fact an arterialisated myocutaneous flap whose excellent reliability is directly correlated with its axial pattern of vascularisation.

In Goldstein’s words, the ‘elastic flap’ is a composite flap with either the superior or the inferior labial artery sandwiched within the orbicularis muscle between the labial mucosa and the vermilion skin; it is a hardy surgical procedure engaging vermilion as a readymade aesthetic sub-unit sitting on the lower-third of the face with resulting scars hidden within the natural anatomical borders of the reconstructed lip feature.\textsuperscript{6,7}

Other authors later introduced a double advancement of vermilion musculomucosal flap. Sawada et al. harvested bilateral flaps on either side of a mid-vermilion border defect and closed the gap by advancing each flap towards each other.\textsuperscript{25}

Ohtsuka and Nakaoka also recommended bilateral vermilion flap repair in five patients for defects ranging from about two-fifths to three-fifths of the lower lip.\textsuperscript{26} Mutaf et al. later reported a modification of Goldstein’s elastic lip flap to treat congenital sinuses of the lower lip.\textsuperscript{27}

To what is known to us, the idea of harvesting both upper and lower vermilion musculomucosal flaps for

![Figure 4](image)

(a) Defect after right oral commissure squamous cell carcinoma (SCC) excision in an 82-year-old patient. The flaps have been fully mobilised. (b) The same patient 25 months after surgery. The V-Y flap drawn at initial surgery was eventually omitted since deemed unnecessary. This caused some stretch of the lateral vermilion inferiorly.

![Figure 5](image)

(a) Squamous cell carcinoma (SCC) of lower lip and commissure in a 64-year-old patient. (b) Aspect at 3 months after surgery. The large inferior V-Y flap prevented caudal stretch of the lateral vermilion. However, the position of the commissure is somewhat low and especially too lateral due to overcorrection.
commisuré defects was first reported by Robotti et al. In a case report published in 1993, they described this technique to perform reconstruction of the corner of the mouth in a patient who had undergone cheek reconstruction with a free radial forearm flap after oncological resection, resulting in an incompetent oral commissure with constant drooling.

In 1999, Fata suggested the use of this surgical method to manage oral commissure deformities secondary to facial gunshot wounds in three patients.

Similarly, Yokoo et al. proposed the association of upper and lower lip vermilion musculomucosal flaps with concomitant free flap transfer in two patients to repair full-thickness cheek defects which involved the oral commissure and vermilion after tumour excision; in their report, the authors stated that the reconstruction can be considered successful only when both sphincteric and sensory functions are restored, thus focusing on the importance of the vermilion advancement flap as an innervated unit.

To our knowledge, this article reports on the largest series of patients treated by upper and lower vermilion advancement musculomucosal flaps for oral commissure defects.

A few comments warrant attention when considering anatomy, technique, and outcome, both regarding function and aesthetics.

Both upper and lower flaps are very safe, since they are nourished by axial vessels. This guarantees that dissection can be brought very close (1 cm) to the contralateral commissure to allow maximum, tension-free stretch.

Regarding innervation, both upper and lower flaps in part remain innervated and in part regain their innervation.

Figure 6  (a) Complex left oral commissure gunshot-wound deformity in a 32-year-old patient. Cheek mucosa had been directly sutured to the skin laterally. (b) Triple adjacent-cheek V-Y advancement flaps reduce the size of the resulting defect to that of the commissure. Upper and lower vermilion advancement musculomucosal flaps have been fully raised almost to the contralateral angle of the mouth.

Figure 7  (a) A wide defect resulting from squamous cell carcinoma (SCC) excision and neck dissection. A rotation cheek flap is planned, with the secondary defect to be re-surfaced by an island flap on the frontal branch of the temporal artery. (b) Post-operative view at 3 months. (c) Satisfactory function of the muscle ring.
through later neurotisation, like, for instance, a conventional Abbe flap. In fact, Gillies originally documented restoration of oral competence in the rotated orbicularis, and, later, Rea et al. proved electromyographic evidence of nerve regeneration. However, some of the original innervation remains, since, by performing a combination of sharp and blunt dissection under magnification when separating the orbicularis portion of the flaps (similar to the technique used to raise a Karapandzic flap), at least some sensory or motor nerve branches which radially reach the orbicularis are detected and preserved at the time of surgery.

Successfully regained function will also depend on the careful surgical synthesis of the extremities of each superior and inferior orbicularis oris, which allows reconstitution of a neo-modiolus with restoration of dynamic function of the orbicularis ring.

In our primary reconstruction, after the lesion is excised, the ideal anatomical support for neo-modiolus restoration will be either the residual buccinator muscle or the flaps transposed or advanced from the cheek when the defect is too large (Figures 6a, b and 7a–c). These flaps should be employed as needed, so as to reduce the final defect to the exact size of the tapered end of the myomucosal lip advancement flaps and thus avoid postoperative outwards stretching of the neo-commissure. In addition, in primary cases, as already mentioned, a simultaneous static cranially–obliquely directed suspension of the neo-modiolus is performed with non-absorbable suture passed through the subcutaneous tunnel to the tragus. Of course, it is somewhat difficult to exactly gauge the degree of suspension, as well as the extent of lateral overcorrection from the neo-commissure to the midline, as compared to the other side. This is because the variables of postoperative scar contracture, insufficiently opposed by the intrinsically weak residual buccinator muscle and the length of time preceding full reinnervation, are at play,

**Figure 8** (a) Secondarily reconstructed oral commissure after prior radial forearm free flap procedure. (b) Appropriate dynamic action of the restored orbicularis oris muscle.

**Figure 9** (a) Squamous cell carcinoma (SCC) of the left oral commissure in a 59-year-old patient. (b) Good aesthetic result of the same patient 65 months after surgery. (c) Appropriate dynamic action of the restored orbicularis oris muscle.
even more so when local flaps have been employed to reduce the size of the defect. In recent years, we have settled on a lateral, measured hypercorrection of 0.5 cm and on reasonable tension (i.e., not provoking distortion) on the permanent support suture. In secondary reconstructions, of course, the task is much easier because the pre-existing tenacious scar, left as a fibrous unyielding scaffold under the neo-commissure, will stably keep it anchored in its definite position (Figure 8a and b).

A final comment may also be made about the possibility of using the technique described in this article for oral submucous fibrosis (OSF). The occurrence of OSF is usually restricted to Southeast Asia, although a number of cases have been reported in other parts of the world, such as South Africa, Greece and the United Kingdom. This potentially malignant disorder is most likely caused by the habit of chewing areca and betel quid or a substitute and is characterised by progressive limitation in mouth opening and evolution to oral cancer with an annual transformation rate from 1.9% to 10%. Thus, an aggressive surgical approach is warranted.

Although none of the patients of this series was affected with OSF, and given our inexperience in dealing with such a condition, we would still encourage simultaneous advancement of upper and lower lip musculomucosal flaps in those specific clinical situations in which wide oral mucosa release is required and reconstruction of through-and-through defects involving the oral commissure is demanded. Of course, involvement of the oral commissure would have to be strictly unilateral.

Repair of lip defects involving the oral commissure is a challenging endeavour. To this aim, the authors describe a surgical procedure using simultaneous advancement of upper and lower lip musculomucosal flaps.

Advantages include a single-stage operation, avoidance of lipswitching procedures and of mobilization of mucosa and cheek skin, with final scars well camouflaged within the oral mucosa and the mucocutaneous junction.

This technique, because of its reliability and versatility, provides a satisfactory sphincter function with re-establishment of the continuity of orbicularis oris muscle (Figure 9a–c). Thus, oral nutrition and proper speech are re-established even in elderly patients, without any evidence of microstomia (Figure 10a–c).

Innervation, sensation and adequate cosmesis are provided by this operation, which restores the defect with ‘like’ tissue.

Conflicts of interest statement

None Declared.

References