LIP RECONSTRUCTION

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INTRODUCTION

Cancer of the lip is a relatively common malignancy of the head and neck region. Squamous cell carcinoma most frequently occurs in the mucosa of the lower lip, while basal cell carcinoma is the most common cancer of the cutaneous portion of the upper lip. Obviously cure should always be prioritised over reconstruction. As tissue conservation is critical in this location, tumour extirpation is ideally accomplished through meticulous margin control as permitted by Mohs micrographic surgery. For reconstruction of the lip unit, a large spectrum of modalities have been described. To obtain consistent optimal results, a combination of reconstructive skills and aesthetic sensitivity is required.

ANATOMY

The lips comprise two mobile structures that represent the anterior boundaries of the oral cavity. The lips function dynamically in deglutition, speech and facial expression[9]. The skin of the lip is intimately attached to the orbicularis muscle. The orbicularis oris muscle forms the bulk of the lip and is arranged in a circular fashion. Maintenance of continuity of the orbicularis is highly important for oral competence. In opening and closing of the mouth the orbicularis works synergistically with a group of dilator muscles arranged in a radial fashion around the mouth. Blood supply comes from superior and inferior labial arteries, which are branches of the facial artery. These arteries run submucosally just on the internal side of the lip vermilion forming a vascular arcade. The buccal and marginal mandibular branches of the facial nerve supply the motor innervation. The first echelon lymphatic drainage is to the submental and sub-mandibular lymph nodes (level I).

Boundaries of the anatomic lip unit include melo-labial creases, base of the nose and mental crease (Fig. l). The upper lip itself may be divided into 3 smaller topographic units. The philtral column, nostril sill, alar base and nasal-labial crease border both lateral subunits. The medial topographic subunit includes the philtrum itself[4]. A thin pale junction zone of skin (white line) separates the cutaneous part of the lip from the vermilion portion. This junction zone should be aligned correctly for adequate aesthetic lip repair. The lower lip presents as a separate anatomic unit.

The borders of the aesthetic units afford an excellent location for camouflage of scar lines in lip repair. When a large part of the subunit of the lip is missing, consideration should be given to replace the entire subunit rather than simply patching the defect. In essence, a relatively larger operation aims to place the scar at the subunit transition zones[4]. As the creases often distinctly outline the anatomic unit, distortion of these lines in reconstruction should be prevented. In general, incisions should preferably be
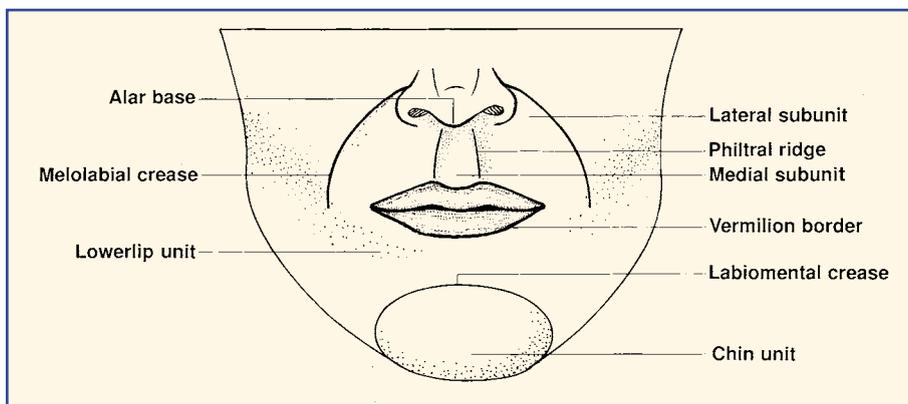
Fig. 1. Lip anatomy with defined structural boundaries and surrounding aesthetic units. Delineating 2 lateral and 1 central upper lip sub-units, whereas the entire lower lip represents a separate aesthetic unit.

limited within the lip unit and not extend across these anatomic borderlines. Relaxed skin tension lines of the lip are oriented in a radial fashion around the mouth. They have a perpendicular orientation with respect to the underlying circular orbicularis oris muscle[28]. Age related wrinkle lines do follow these relaxed skin tension lines and thus are indication for preferred incision placement.

RECONSTRUCTIVE STRATEGIES OF THE UPPER AND LOWER LIP

Functional goals of lip reconstruction include maintenance of oral competence, sufficient oral access and preservation of sensation. Aesthetically, facial units should be reconstructed with adequate tissue match in terms of colour and texture, aiming at symmetry as well as preservation of the apparent commissure and philtral structures[9]. The four main reconstructive options include secondary intention healing, skin grafts, primary closure and local flaps. The first two, secondary intention healing and skin grafting have little application in the lip unit. However, some smaller size cutaneous defects away from the lip vermilion may indeed do well by secondary intention healing. With appropriate care, the wound heals by scar contraction and epithelialisation. Thus, an upper lip defect high along the nasal and labial crease is an established favourable site for secondary intention healing[51]. Wounds near the lip or large sized defects, which are led to heal by secondary intention, may risk wound retraction and distortion (Fig. 2)[28]. Skin grafts are infrequently placed on the lip. The lip is relatively mobile tissue, necessitating extra precaution in proper immobilisation for successful graft take. Full-thickness skin grafts are preferred over split-thickness skin grafts because of their better colour match and lower tendency for contraction. Skin grafts are only used in high-risk lesions or in situations when flap reconstruction is not readily available. After adequate time has elapsed for observation, the graft may be removed and secondary reconstruction with flaps can be undertaken. However, Mohs micrographic surgery for tumour control has largely obviated the need for temporary skin grafting.

Fig. 2a. Patient present with multiple previous basal cell carcinomas in the facial region. Moderately sized defect on the upper lateral portion of the lip. More superficial smaller defect on the skin vermilion border.

Fig. 2b. Reconstruction with rotation flap and secondary intention healing of the upper defect. Secondary intention healing of the lower defect.

Fig. 2c. Final result. Upper defect nicely healed within aesthetic borders. Secondary intention healing of the lower defect has led to some interruption of the white line skin-vermilion border of the lower defect.

In general the highest degree of aesthetic camouflage in lip reconstruction is obtained by primary closure and with adjacent or local flaps. A special caveat regarding primary closure is that the vertical scar may contract resulting in pull from the vermilion border. Again, care should be taken to respect the anatomic subunit borders if possible. For example, incisions for primary closure should stop shortly (sometimes using an M-plasty) or cross vertically over the vermilion border.

Advantages of primary closure and local flaps include rapid healing and return to normal function, high success rate and excellent cosmesis in most cases with low risk of complications. In addition to improving cosmetic results, flaps can add greater bulk to the reconstruction, specifically in larger defects. One should note that tissue reservoirs of flaps to be harvested within the aesthetic upper lip unit itself are limited. With a mobile free margin and prominent philtral crests minimal closure tension may distort the presented anatomic features. Thus reconstruction of larger defects involves bringing in tissue from the melolabial fold and cheek area as a skin flap or from the opposite lip as a pedicled composite skin-muscle-mucosa flap[4].

UPPER LIP RECONSTRUCTION

The lateral lip subunit

Small defects (less than 10% of the total upper lip width) in the lateral subunit can usually be incorporated into a vertical ellipse on the upper lip skin. Simple advancement and primary closure may be subsequently performed.

Medium sized cutaneous defects involving the lateral cutaneous upper lip are preferably closed using a subcutaneous island pedicled flap[35]. One side of the subcutaneous triangular shape is aligned to the melolabial fold. As subcutaneous tissue in the upper lip itself is scarce, a lateral-superiorly-based subcutaneous cheek pedicle is developed

Fig. 3a Subcataneous island pedicle flap is outlined subcatanous cheek pedicle for a lateral high upper lip defect.

Fig. 3b. Incisions medially carried to the level of the orbicularis oris muscle, more laterally undermining in a subcutaneous plane to develop a laterally based subcutaneous pedicle.

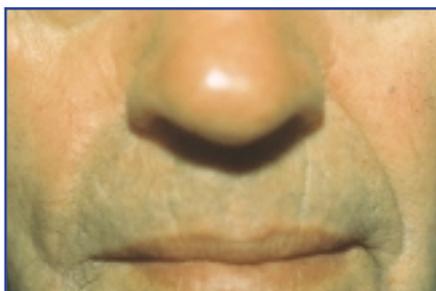Fig. 3c. Advancement of the flap sutured in place.

Fig. 3d. Postoperative result with fair scars hidden in anatomic borders.

permitting advancement of the skin flap while rotating the pedicle[7].(Fig. 3) The underlying facial musculature should not be violated. If the defect does not extent to the alar base, some remaining normal skin may be removed in order to position the final scar into the nasal base/upper lip-transition zone. Some pincushioning must be anticipated which will fade overtime. Alternatively, a medially based rotation flap may be considered, but a significantly sized medially based rotation flap has the potential of distortion and outward pull of the vermilion.

Defects of the lateral third of the upper lip may alternatively be reconstructed by bringing in medial cheek tissue using advancement flaps or transposition type flaps. The incisions are well camouflaged within facial unit junctions. A main disadvantage of these cheek donor flaps is the obliteration of the melolabial fold. Obliteration of the melolabial fold by the flap pedicle can be corrected by secondarily placing an incision across the pedicle and surgically recreating a fold, or at least a line of scar that simulates the melolabial fold[29]. To facilitate medial advancement of a sliding cheek flap, impeding tissue above (naso-facial junction) and below (melolabial fold) the defect is excised. If a large portion of the lateral upper lip unit is missing, consideration should be given to reconstruct the entire lateral surface and unit with a large melolabial, inferiorly based, transposition flap.

Fig. 4a. Near total defect for the lateral lip unit. Large inferiorly based melolabial transposition flap outlined for closure of the complete lateral aesthetic subunit.

Fig. 4b. Flap transposed. Cheek donor site closed by undermining and advancement. The standing cone deformity at the vermilion border left in place for secondary revision to ensure flap viability.

Fig. 4c.Final result with scars in aesthetic unit borders.

The melolabial flap is transposed into the defect and the cheek is advanced to close the donor site (Fig. 4). Larger cutaneous defects of the medial upper lip often require advancement of the entire lateral aspect of the upper lip and medial cheek for closure. Incisions should be made preferably immediately below the nose and above the lower vermilion. In other words, the surgical defect is often enlarged to include the full height of the upper lip to hide the scars below the nose and the lower vermilion border in the aesthetic unit junctions. Excision of peri-alar crescents promotes cheek tissue advancement and reduces closure tension, which can distort the philtrum. This type of repair is specifically limited to patients with a poorly defined philtral crest and Cupid's bow[17]. Cutaneous defects near the vermilion border, but not extending over it, may be closed in an A-T fashion. On both sides of the defect, the incision is extended along the cutaneous-vermilion border to develop two rotation flaps while incorporating a triangular excision in the reconstructive procedure. The final T-shaped closure has favourable scars in relaxed skin tension lines and along the aesthetic unit borders (Fig. 5). However, the dimension of the defect particularly along the vermilion presents a limiting factor for A-T reconstruction. Remember that the laterally developed flaps are relatively short, minimally curved rotation flaps that tend to pull up the vermilion border on approximation.

Fig. 5a. Moderately large defect medial upper lip. Unilateral cephalicaly based advancement/rotation flap with Burow triangle outlined.

Fig. 5b. Flap in position. Area undermining marked with dotted lines.

Fig. 5c. Final result.

The central lip unit

Cutaneous defects less than 50% of width of the philtrum may be reconstructed by side-to-side approximation and closure. However, the risks involved include an unnatural flattening and loss of Cupid's bow. Moreover, additional scar contraction may pull the vermilion border upwards, necessitating revision by Z-plasty. Defects larger than 50% of the width of the philtrum are better reconstructed by bilateral advancement flaps. Bilateral advancement flaps are particularly useful in larger defects extending beyond the natural borders of the philtrum. Grafts in the philtral area are difficult to immobilise which may render them unreliable. Consideration may be given to graft replacement of the complete cosmetic philtrum unit in order to achieve a more natural appearance (Fig. 6)[40]. Lower philtral defects involving less than 50% height of the philtrum may be repaired with a subcutaneous island flap creating bilateral peripheral, albeit thin, subcutaneous pedicles[17].

Defects of the upper lip vermilion

Defects that involve the vermilion of the upper lip may be restored using adjacent oral cavity mucosa. The mucosa is advanced and redraped over the orbicularis oris muscle. For additional mucosal movement V-Y advancement flaps or bilateral rotation flaps may be advantageous[10]. However, closure tension risks flap necrosis as well as flattening of lip contour. Alternatively, local vermilion flaps in a variety of movements may also be considered. A single advancement flap or A-T closure may be obtained in small vermilion defects. Vermilion mucosa flaps may also be transposed from the lower to the upper lip[49]. Another alternative is grafting of palatal mucosa to provide bulk and contour[43]. Almost invariably, sensory return in vermilion reconstruction is less than perfect.

Full-thickness defects of the upper lip

If the orbicularis muscle is partially removed, repair is obligatory[36]. Full-thickness lesions require a multi-layered repair. A skin-orbicularis defect may sometimes be converted into a through-and-through wedge type defect and thus be reconstructed. Obviously, sometimes a relatively large amount of normal tissue is sacrificed. Again, any type of advancement flap may cause asymmetric philtral columns in the upper lip. Specific

Fig. 6a. Defect 75% of philtrum.

Fig. 6b. Defect enlarged till columella base to reconstruct the whole central unit.

Fig. 6c. Skin perichondrial graft harvested. Conchal wound left to heal by secondary intention healing after fenestration of the auricular cartilage.

Fig. 6d. Graft in place. Bolster sutures. Graft relatively large anticipating contraction.

Fig. 6e. Uneventful healing of conchal bowl.

Fig. 6f. Reasonable result. Some scarring visible.

attention should be given to approximation of the mucosa, muscle, subcutaneous tissue and finally the skin surface, resulting in a multi-layered closure. Marking prior to local injection of the "white line" cutaneous vermilion border allows precise approximation[47]. In case of a laterally placed defect, a wedge type excision may include a slight angularity of the lateral vermilion incision. This facilitates precise matching of the high medial vermilion cutaneous junction to the low lateral vermilion border[6]. The primary indication for use of this type of advancement flap is for repairing defects that result in tissue loss of less than 1/3 of the lip.

Full-thickness defects in the upper lip that are greater than 1/3 of the length require alternative flap reconstruction. For defects greater than 1/3 and less than 2/3 of the length the Abbe cross-lip transposition flap is an excellent choice for reconstruction[4,39]. The Abbe flap is outlined on the lower lip to be approximately 1/2 the width of the defect. The height of the flap should equal the vertical dimension of the defect[19]. Classically, the Abbe flap is designed on the lower lip ending at the superior border of the chin prominence. However, the flap may be extended beyond the chin margin for upper lip defects extending into surrounding aesthetic subunits[19]. On the medial side the flap is not completely incised to preserve the supporting labial vessel which is located deep to the vermilion. A layered closure is applied. After two to three weeks the pedicle is be

Fig. 7a. Upper lip alar vestibulum defect reaching on to the buccal mucosa.

Fig. 7b. Defect converted into a through-and-through defect with outline of advancement flap including a cephalad melo-labial transposition flap. The latter flap is used for vestibular reconstruction.

Fig. 7c. Upper lip alar vestibulum defect reaching on to the buccal mucosa.

Fig. 7d. Final result. Patient declines revision of the alar inset with a composite graft.

divided with final inset of the tissue. The flap is a non-sensate two-staged reconstruction with the risk of relative microstomia when applied in larger defects. Aesthetic drawbacks include pincushioning and possible vermilion border malalignment. Consideration should be given to replacement of the entire lateral subunit by the Abbe flap in order to hide the scars at the borders of the lateral subaesthetic unit and recreate symmetry[4]. Through-and-through defects extending into the nasal vestibule may alternatively be reconstructed with a full thickness cheek advancement flap including a peri-alar extension (Fig.7)[41].

Through-and-through defects larger than 2/3 of the upper lip may be reconstructed with full-thickness bilateral advancement flaps and peri-alar crescent excision sometimes in combination with a central Abbe flap from the lower lip. Total upper lip defects are best amenable using full-thickness flaps in combination with various types of mucosal flap. A novel approach is the usage of microvascular flaps for total upper lip recon-struction[22,38]. When required vascularised muscle or tendon can easily be transferred with the neuro-fasciocutaneous flap as a compound flap (Fig. 8).

Fig 8a. Intraoperative view of subtotal upper lip defect. Note partial reconstruction of maxilla with non-vascularised bone from the iliac crest.

Fig 8b. Reconstruction with free myocutaneous latissimus dorsi flap.

LOWER LIP RECONSTRUCTION

Defects of the lower lip vermilion

Small deficiencies of the lower lip vermilion may be closed by vertical V-Y advancement of labial mucosa[18].

Vermilionectomy (i.e. lip shave) defects can be closed by advancement of remaining lower lip or buccal mucosa. This should preferably be performed without too much undermining of the mucosa in order to preserve as much sensation to the lower lip as possible. However, some undermining is necessary to prevent inward retraction of the lower lip and to maintain the full appearance of the lower lip. Alternatively, a laterally based bi-pedicled labial mucosa flap may be considered[2,48]. Intermediate defects of greater length can be closed by a bi-pedicled flap from the upper lip[2]. For larger loss of volume of lower lip the staged ventral tongue flap can be used, which is divided 14 days after transfer[3,24].

Partial-thickness defects of the lower lip

Small defects can often be closed primarily with the scar along relaxed skin tension lines. Larger defects need some form of local flap. Good aesthetic results can be obtained with uni- or bilateral horizontal advancement flaps with incisions along the vermilion border and labio-mental crease. Alternatively an inferiorly based melolabial flap for lateralised defects can be used[29,44]. The donor site can be closed primarily with scars hidden in the melolabial fold.

Full-thickness defects of the lower lip

Small-sized lesions up to about one third of the lower lip are usually resected by traditional wedge excision with primary layered closure. The easiest technique uses a two-layered closure in which the mucosa-muscle-subcutaneous layer and the skin are sutured separately. The first layer is a mattress suture by which the mucosa is everted[26]. Whereas the classical V-shaped excision is suitable for smaller lesions (maximum of 1.5 cm), larger defects should be excised by a W or pentagonal excision to avoid crossing the labio-mental crease. Notching of the scar in the vermilion is prevented by everted

layered closure. A Z-plasty may be incorporated in the design or performed as a secondary procedure. Since squamous cell carcinomas of the lower lip are often accompanied by pre-cancerous changes of the remaining of the vermilion a combination of wedge excision with a lip shave is often performed (Fig. 9). A wide rectangular excision measuring up to one half of the lower lip (3.0 cm) may be reconstructed using relaxing incisions along the labio-mental crease creating uni- or bilateral full-thickness composite advancement flaps.

Medium-sized defects (from 1/3 to 2/3) of the lower lip require some form of local flap repair using adjacent lip tissue. Removal of bilateral crescents along the labio-mental crease may be necessary to facilitate closure as in the Schuchardt flap[33]. An alternate method of functional reconstruction of the central part of the lower lip is the bilateral step or staircase design[15,20]. Several advantages of this technique can be noted. The direction of the muscle fibres are not altered, the broad pedicle of the step flap preserves innervation and prevents atrophy and the commissures are left intact. The main draw-back is the unnatural geometric incision that does not follow the labio-mental crease.

Fig. 9a. Intraoperative view during closure of V-shaped defect lower lip including lip shave.

Fig. 9b. Late postoperative result.

Karapandzic's technique for large defects of the lip, involves unilateral or bilateral full-thickness circumoral advancement-rotation flaps[14,16]. The key feature of this reconstruction technique is preserving the neural and vascular structures that are encountered in the plane of dissection, so that optimal oral competence and sensory functions are preserved. The releasing incisions of this orbicularis oris musculocutaneous flap are placed around the periphery of the anatomic lip unit and should be masked within the labio-mental and melolabial creases (Fig. 10). Meticulous closure is warranted to obscure as much as possible the extensive incisions. There is a certain tendency for blunting of the oral commissures, though this is not usually a major problem. Moreover microstomia may occur as the defect is reconstructed with remaining lip tissues. Secondary correction of the mouth opening, however, is seldom needed, since there is some ability to widen the mouth opening over time. For defects measuring up to two-thirds of the central lower lip most surgeons currently prefer the Karapandzic flap. For the reconstruction of defects of the lateral parts of the lower lip the Abbe or Estlander cross-lip transposition flap may alternatively be employed depending of involvement of the commissure. The Abbe flap, is outlined on the upper lip to be half the size of the defect as measured along the vermilion[1]. In this way both lips will be shortened by

Fig. 10a. Defect measuring half of the lower lip (including simultaneous lip shave). Note markings of unilateral Karapandzic flap and resection of skin triangle. For defects measuring more than half of the lower lip bilateral flaps are needed.

Fig. 10b. Intraoperative photograph depicting movement of innervated flap into the defect.

Fig. 10c. Late postoperative result.

Fig. 10d. Final result with mouth openend, demonstrating relative microstomia without fuctional sequelae.

equal amounts thereby carrying the risk of relative microstomia. Both the recipient and the donor site are designed as V-shaped wedges in order to facilitate closure. The donor site is selected so that it may be rotated into the defect with as minimal distortion as possible. On one side the flap is not completely incised to preserve the supporting labial artery. A multi-layered closure is applied and great care should be taken in aligning the vermilion border. The pedicle can be safely divided after 2 weeks (Fig. 11).

Fig. 11a. Defect measuring more than 1/3 of lower lip. Note markings of Abbe flap from upper lip measuring about half of the defect and removal of excessive skin crescent in labiomental crease to facilitate closure.

Fig. 11b. Intraoperative view during closure of a V-shaped defect lower lip including lipshave.

Fig. 11c. Result after inset of flap with pedicle still attached.

Fig. 12a. Defect of both lips in the region of the corner of the mouth. Note marking of skin resections according to Zisser [50].

Fig. 12b. Intraoperative view after resection of skin triangles.

Fig. 12c. Direct postoperative view after primary closure of skin edges and mobilisation of buccal mucosa.

Fig. 12d. Final result. Both vertical scars were secondarily revised by multiple Z-plasties to correct gaping of the neocommissure.

Although sensory recovery is prolonged this is usually not a problem since the sensation in the remaining lower lip is adequate for function. Pincushioning of the flap can occur and may be disfiguring. For defects involving the commissure the Estlander flap with the pedicle located medially, is rotated into the defect as a single-staged procedure[8]. Blunting of the commissure can be expected which may need subsequent revision surgery in the form of a commissuroplasty[30]. Defects that involve both lips in the region of the commissure may be reconstructed by means of a horizontal incision in the cheek and de-epithelisation of two triangular areas, which are covered with undermined buccal mucosa[50]. Since no orbicularis muscle is retained at the level of the neocommissure some degree of gaping of the commissure must be anticipated. This may need subsequent correction by means of multiple Z-plasties along the two vertical scars to bring the lips together (Fig. 12).

Subtotal defects (greater than 2/3) of the lower lip defects need transfer of adjacent cheek tissues or tissue from distant sites. In the 19th century Bernard and Von Burow separately described a method for reconstruction of major full-thickness defects of the lip[23]. It involves direct medial advancement of tissue from the cheeks, which is facilitated by removal of strategically placed triangles of skin (Von Burow triangles) that allow for a more even redistribution of the facial tissues. The procedure was originally done with full-thickness incisions, but was later modified to minimise disruption of the facial

Fig 13a. Defect of total lower lip and chin.

Fig 13b. Radial fore arm flap still attached to left arm. Note neurovascular pedicle.

Fig 13c. Single staged reconstruction by sensate free radial forearm flap. Fascia lata was used as sling for flap support. Neural anastomosis was performed between lateral cutaneous nerve of forearm and mental nerve. Note adjunctive lowering of right commissure.

Fig 13d. Late postoperative result. Patient refused further refinement of vermilion.

musculature. Other surgeons, most notably Freeman and Webster, have described myoplastic modifications, which attempt to produce more favourable lines of scar and better muscle function[11,45]. Overall functional and cosmetic results with this method of reconstruction are generally only fair because satisfactory restoration of the orbicularis sphincter is often difficult to achieve. A large variety of other techniques, e.g., Dieffenbach's flap and its refinement the McHugh sliding flap, Gillies fan flap (a variation on the Estlander flap) and its modification by McGregor have been described which can transfer tissue from the cheek into the lip[13,23,25,27,42]. Currently, the preferred reconstruction method for subtotal lower lip defects is a free flap or - if this is not possible - bilateral Karapandzic flaps[16,31,37].

Total lower lip defects require reconstruction with some form of distant flap or with a microvascular free flap. In general, distant flap reconstructions (such as flaps from the scalp and forehead, the submandibular, deltopectoral, and pectoralis major flap) are capable of providing tissue for wound closure and replacement of the lip but are not able to restore an adequate functional lip. Transfer of microscopically revascularised sensate tissue from the forearm has the potential of restoring competence and sensation in (sub-) total lower lip defects in a single-stage procedure. It was first described by Sakai et al. in 1989 and currently less than twenty cases have been reported in the literature[5,31,32,34,46]. The palmaris longus tendon is incorporated in the neuro-facio-

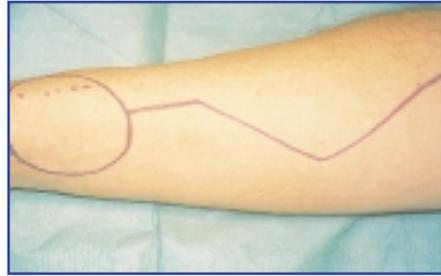*Fig. 14a. Large chin defect exposing mandibular bone.*

Fig. 14b. Outline of radial forearm flap on right arm. Note proximal incision for pedicle dissection.

Fig. 14c. Isolated flap. Note radial artery (below) and cephalic vein (above).

Fig. 14d. Early postoperative result of reconstruction by free radial forearm flap.

cutaneous flap as a vascularised graft to function as a sling between the two commissures. Alternatively, flexor carpi radialis tendon or a non-vascularised folded fascia lata graft can be used as a sling over which the radial forearm flap is draped. Microneural anastomosis is done between the cutaneous nerve of the forearm and the cut end of the mental nerve (Fig. 13). After a few months adequate two-point discrimination in the flap is achieved. Medical tattooing or free grafting of cheek mucosa can restore lower lip vermilion[12]. Free tissue transfer, by means of osteocutaneous free flaps based on the peroneal (fibula flap) or deep circumflex iliac vessels (iliac crest flap) offer the best reconstruction method for the anterior mandible defect.

For major chin defects the thin, pliable radial forearm free flap gives excellent results in a single staged procedure. Some difference in skin colour between the forearm and the face should be anticipated, but this is usually not of major concern to the patient (Fig 14).

CONCLUSION

The reconstructive approach to lip defects should make every attempt to preserve function and cosmesis with a minimum amount of morbidity. Local flaps are the mainstays of the reconstruction of the lip-chin complex, but massive defects may need free flap reconstruction.

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