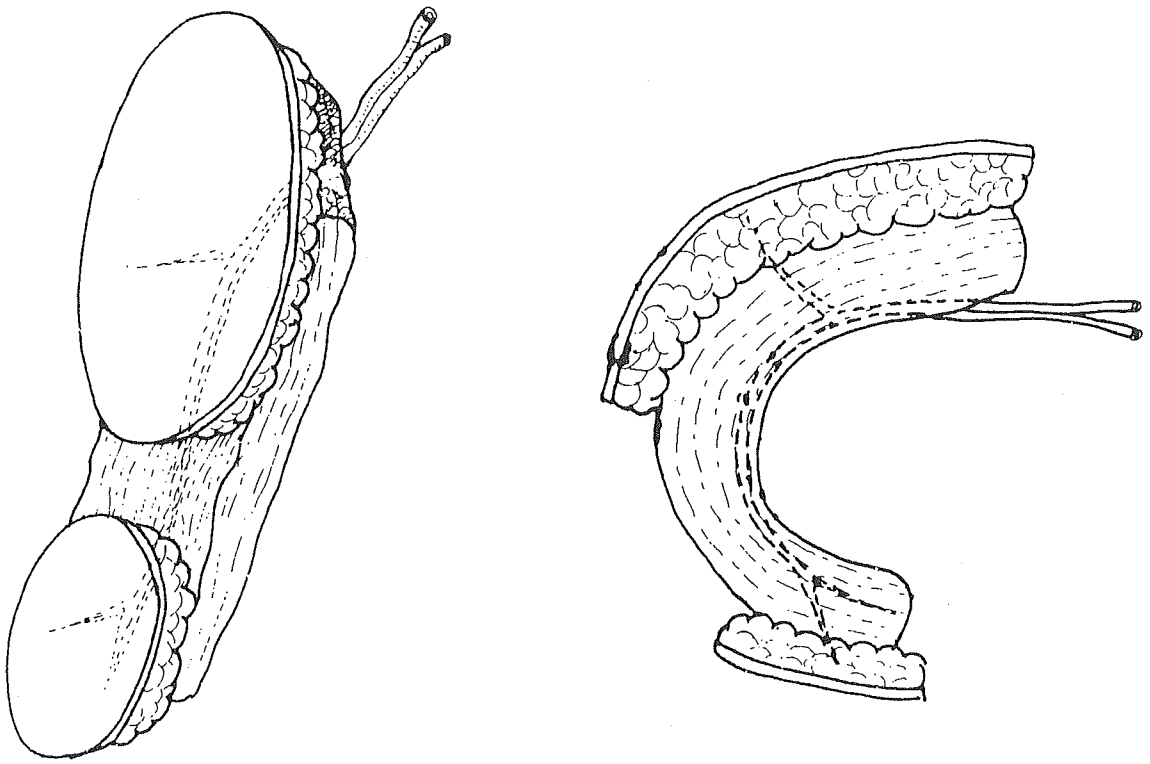

FIGURE 79-16. Schema of a folded free musculocutaneous flap available for simultaneous closure of a full-thickness cheek defect.

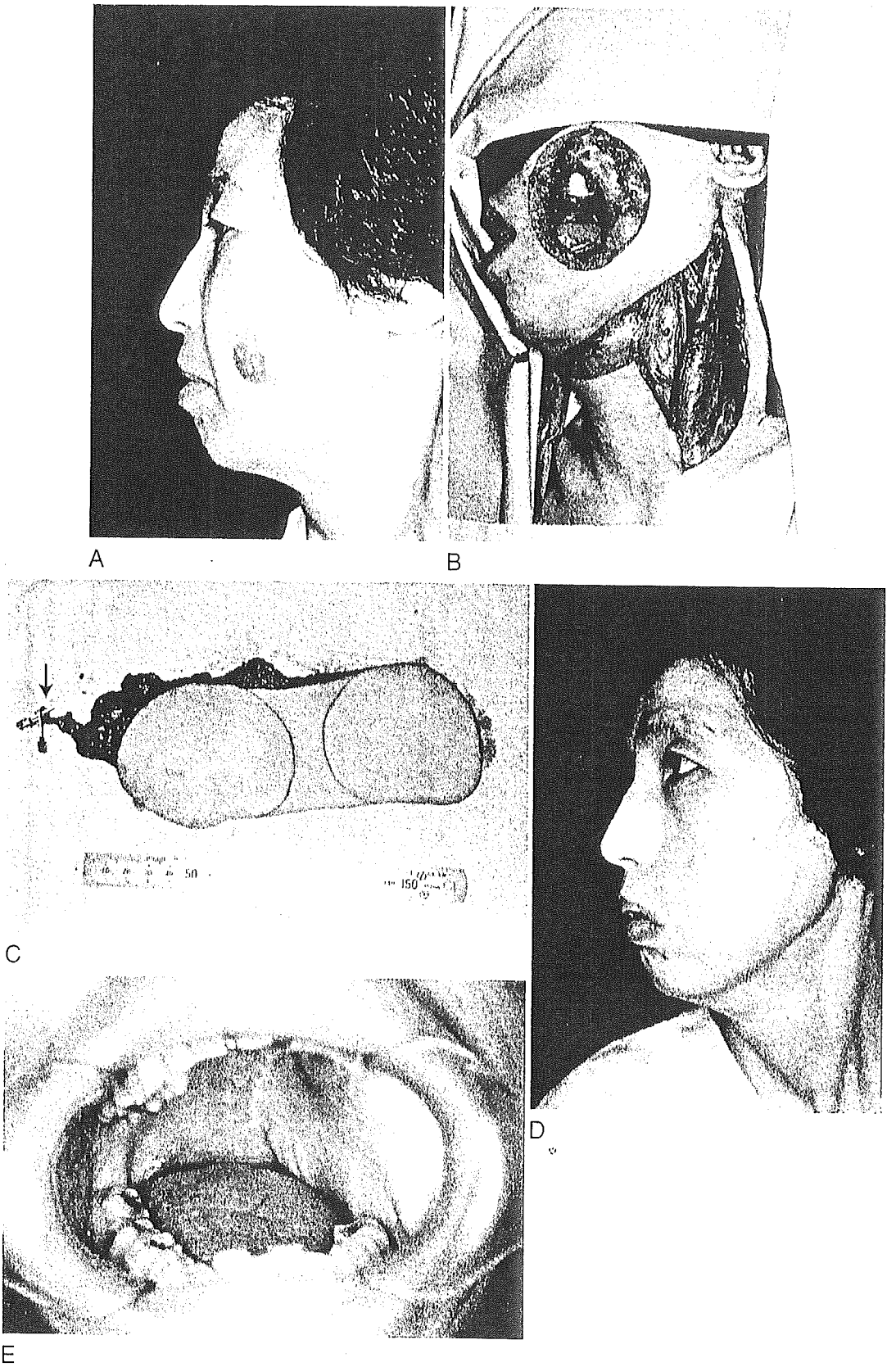

FIGURE 79-17. A 55-year-old woman with squamous cell carcinoma originating from the left buccal mucosa and invading the cheek skin. *A*, Preoperative view. *B*, A full-thickness cheek defect after extensive resection of the tumor and modified neck dissection. *C*, An isolated rectus abdominis flap is going to be folded (arrow shows the pedicle inferior epigastric vessels). *D* and *E*, Five years postoperatively, good closure of both external surface and internal lining is achieved in a single operation. (From Nakatsuka T, Harii K, Yamada A, et al: Versatility of a free inferior rectus abdominis flap for head and neck reconstruction: analysis of 200 cases. Plast Reconstr Surg 1994;93:762-769.)

anterolateral thigh flap, offer excellent reconstructive options.

Skeletal Defects

When a maxillary defect is small and has good soft tissue coverage, an autogenous free bone or costal cartilage graft can survive. Bioinactive or biocompatible alloplastic materials, such as titanium mesh and hydroxyapatite, may be advocated when poor local tissue factors such as irradiation and scar do not exist. In contrast, a vascularized bone graft or osteocutaneous flap can reliably provide various types of vascularized bone segments with or without cutaneous flaps for osseous reconstruction of maxillary defects. These flaps can recruit the missing buttresses of the maxilla so that facial contour can be maintained aesthetically. The free scapular osteocutaneous flap is among the most preferred donor flaps because it can simultaneously provide a well-vascularized segment of the lateral border and inferior angle of the scapula as well as skin.[42] Great freedom in spatial orientation of skin and bone segments enables the surgeon to achieve a three-dimensional reconstruction of a complex defect of the maxilla and midface (Fig. 79-18). A relatively thin scapular bone segment may also be an option for reconstruction of a maxillary bone defect. A long stalk of the circumflex-subscapular vessel pedicle can be anastomosed to the external carotid branches, but an interpositional vessel graft or flow-through flap should be used when the recipient vessels are beyond the length of the flap's vascular stalk.[59] The authors recommend employing a radial forearm flap as a flow-through flap in patients with severe midfacial deformities after treatment of maxillary cancer for which several types of tissue flaps including vascularized bone segments are required. In most instances, a scapular osteocutaneous flap is attached to the distal stump of the radial vessels when a maxillary buttress needs to be reconstructed (Fig. 79-19).

The angular branch of the thoracodorsal vessels can also nourish the inferolateral segment of the scapula[60] and be transferred with a latissimus dorsi flap for reconstruction of type V defects. A combination scapular flap, latissimus dorsi flap, and serratus anterior flap, sometimes including ribs, is available for reconstruction of multiple defects in the midface.[61,62]

Muscle Defects

Irreversible or long-standing facial paralysis due to permanent damage to the facial nerve, resection of the mimetic muscles, or congenital deficiency is one of the most challenging problems in midfacial and cheek reconstruction. Microneurovascular free transplantation of various skeletal muscles has now been popularized and is a well-established procedure, often yielding natural or nearly natural cheek movement on smiling.[63-66] For a successful result to be obtained with this procedure, selection of an adequate motor nerve in the cheek is extremely important. In some patients who have undergone tumor resection including the facial nerves and mimetic muscles, a residual branch of the facial nerve may be available for reinnervation of a transplanted muscle. Because suitable facial nerve branches are frequently unavailable in the paralyzed cheek, a two-stage method combining a cross-facial nerve graft and muscle graft has long been championed and promises a good result with a natural or nearly natural smile.[64,65] However, this procedure requires a staged operation and a lengthy waiting period before contraction of a transplanted muscle is obtained. Sequelae such as hypoesthesia and paresthesia in the lateral foot after harvesting of a sural nerve segment for a cross-

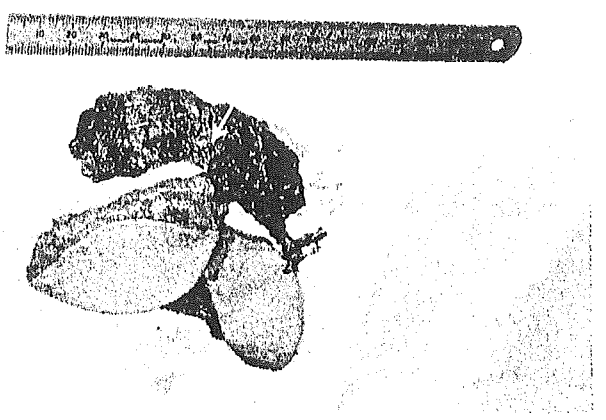

FIGURE 79-18. A scapular osteocutaneous flap with two separated skin paddles (arrow shows a vascularized scapular bone segment).

FIGURE 79-19. A severe cheek deformity in a 45-year-old woman after treatment of a right maxillary carcinoma. *A*, Preoperative view. *B*, A sequentially linked radial forearm flap (R) with a scapular osteocutaneous flap (S) is shown. The radial forearm flap was used to reconstruct the oral mucosal defect, and the scapular osteocutaneous flap was used to reconstruct the upper horizontal buttress of the maxilla and augment the depressed cheek. The radial vessels of the forearm flap were anastomosed to the facial vessels; the circumflex scapular vessels (SA) nourishing the scapular flap were anastomosed to the distal end of the radial vessels (D). *C*, Good facial appearance is obtained 8 years postoperatively.

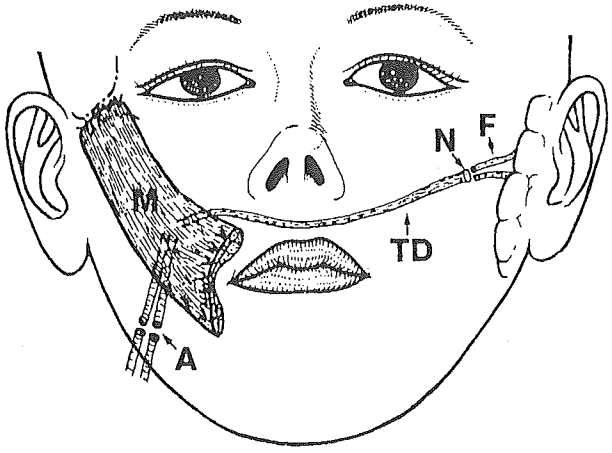

FIGURE 79-20. Schema of the one-stage reconstruction of a paralyzed face with a latissimus dorsi muscle segment in which the thoracodorsal motor nerve is crossed through the upper lip and sutured to the contralateral facial nerve branches. M, latissimus dorsi muscle; A, site of vascular anastomosis; N, site of nerve suture; TD, thoracodorsal nerve; F, intact facial nerve in the nonparalyzed cheek. (From Harii K, Asato H, Yoshimura K, et al: One-stage transfer of the latissimus dorsi muscle for reanimation of a paralyzed face: a new alternative. Plast Reconstr Surg 1998;102:942.)

face nerve graft may also occur and cannot be disregarded.

To overcome the drawbacks of the two-stage method, a one-stage method has been developed with use of the latissimus dorsi muscle segment.[21] The thoracodorsal nerve is directly crossed through the upper lip and sutured to the contralateral nonparalyzed facial nerve branches (Fig. 79-20).[21] Through a preauricular face lift incision on the paralyzed cheek, the cheek skin is widely undermined to develop a subcutaneous pocket to accept a subsequent muscle graft. Through an additional small incision in the submandibular region, the facial artery and vein (respectively) are exposed as the recipient vessels. During preparation of the recipient cheek, a segment of the latissimus dorsi muscle (an average of about 3 cm wide and 8 cm long), with its neurovascular pedicle, is harvested by another operative team. The thoracodorsal nerve should be dissected proximally to its origin from the posterior cord of the brachial plexus to obtain sufficient length (≥13 cm). This provides enough length to reach the contralateral facial nerve branches exposed through a small incision, less than 2 cm long, at the anterior margin of the parotid gland. The isolated muscle segment is then transferred to the recipient cheek and fixed between the zygoma and the nasolabial region under proper tension. The neurovascular anastomoses are then carried out under an operating microscope. Reinnervation of the transferred latissimus dorsi muscle is established at a mean of 7 to 8 months postoperatively (Fig. 79-21).

SUMMARY

Reconstruction of the midface is a challenging and difficult task for reconstructive plastic surgeons. Many defects are composite, involving many layers of skin, subcutaneous soft tissues, maxillary scaffolds, and mucosa. Aesthetic as well as functional results are important because morbidity seriously influences a patient's quality of life. Development of microvascular tissue transfer now offers various reconstructive options and has greatly improved the results of midface reconstruction. Multidimensional approaches, including conventional surgical and prosthetic procedures, however, should be considered in accordance with the individual patient and specific defect.

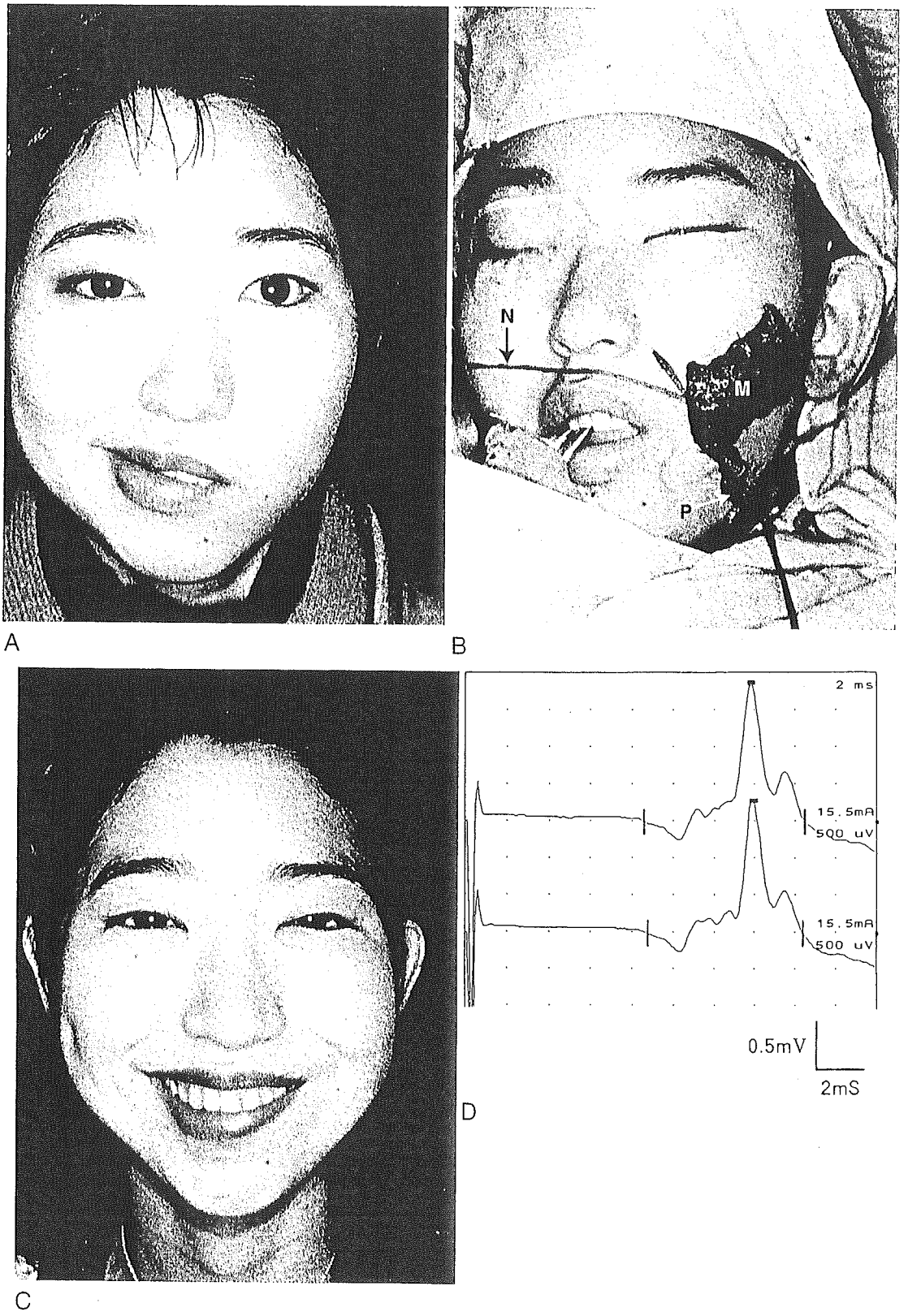

FIGURE 79-21. A 22-year-old woman with severe incomplete left facial paralysis after parotidectomy more than 10 years earlier. *A*, Preoperative view on smiling. *B*, Smile reconstruction as accomplished with a one-stage transfer of the latissimus dorsi muscle segment. The transferred latissimus dorsi muscle is shown. M, muscle; N, thoracodorsal nerve crossing the upper lip to the contralateral cheek; P, thoracodorsal vessels anastomosing to the recipient facial vessels. *C* and *D*, At $3^1/_2$ years postoperatively, a natural smile is obtained with high evoked potentials from the transferred muscle on stimulation of the contralateral facial nerve. (From Harii K, Asato H, Yoshimura K, et al: One-stage transfer of the latissimus dorsi muscle for reanimation of a paralyzed face: a new alternative. Plast Reconstr Surg 1998;102:945.)

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254. 頭頸部腫瘍の術後再建

Reconstruction of head and neck defects

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頭頸部腫瘍切除後の再建目的は，欠損組織を補うのみでなく，術後の摂食・会話機能を維持することにある．同時に，手術時間，出血量，再建材料採取部の犠牲，術後の早期回復などを考慮した低侵襲な術式を選択すべきである．このためには，切除側と再建側との間で，術前，術中，術後における密なチームワークが基本となってくる．

■ 術前の評価

患者の年齢や社会的背景，全身状態，誤嚥の有無，既往歴，術前治療の有無などの情報を得る必要がある．口腔・中咽頭癌で，術前より誤嚥がある場合や70歳以上の高齢者では，切除範囲の拡大に伴い喉頭温存を目指した再建は困難になる．糖尿病自体が手術を制限することはないが，不十分な管理下では，術後の創部感染が治癒の遷延や移植組織の壊死に結び付く．放射線治療の照射範囲と線量は，局所皮弁や有茎皮弁の血流，遊離皮弁における移植床血管の選択に関与してくる．基本的に，再建材料は照射野以外の場所より選択したい．また，既往の手術部位に照射が加わっている範囲での血管剝離は不可能に近く，移植床血管を他の部位に求める必要がある．

■ 再建材料部位の評価

再建方法は，1次縫縮，植皮，局所皮弁，有茎皮弁，遊離皮弁と大きく分類される．切除範囲が小さい場合や，再建しなくてもよい機能が得られる場合には，当然，1次縫縮や局所皮弁などが選択となる．切除範囲が広い場合には，有茎皮弁や遊離皮弁となるが，移植組織の自由度や血流の安定性から，遊離皮弁を第1選択とし，有茎皮弁は術後に合併症を生じた場合や再発した場合などに備えたい．

口腔内の局所皮弁としては，舌弁，頬粘膜弁，硬口蓋粘骨膜弁，咽頭弁があり，また頸部皮弁も脱上皮すれば利用可能である．有茎皮弁としては，DP皮弁や大胸筋皮弁がある．遊離皮弁は，全身から多種多様な皮弁の挙上が可能である．しかし，手術時間を考慮すると，腫瘍切除と同時に採取可能な皮弁がよい．また，どの移植床血管でも対応でき，かつ縫着のさいに自由度が高くなるように，血管柄が長い皮弁を選択する．代表的には，腹直筋皮弁，前腕皮弁，前外側大腿皮弁，空腸，そして骨材料としては腓骨が挙げられる．

■ 欠損範囲と再建材料の選択

術前に，腫瘍切除と頸部郭清の範囲，そして遊離皮弁であれば移植床血管の選択について十分に検討する．

●舌欠損　切除後の再建方法は，舌部切，舌半切，舌全摘・亜全摘術によって異なってくる．舌部分切除術では，創部の単純縫縮が可能のことが多く，機能は十分に維持され皮弁などによる再建の必要性はない．舌半切術(可動部舌半切＋舌根半切)では，何らかの再建を施さないと機能障害を残す．移植組織の選択としては，薄い皮弁がよく，前腕皮弁，前外側大腿皮弁などが適応となる．また大胸筋皮弁でも再建可能である．舌全摘・亜全摘術は，嚥下機能のみならず喉頭温存に最も関与してくる欠損である．再建で重要な点は，口狭部が狭くなるような隆起型の形態を作ることである．したがって，大きい皮島面積と皮下脂肪の厚い皮弁，すなわち腹直筋皮弁が第1選択となる．

●中咽頭欠損　上壁のみの欠損であれば，硬口蓋粘骨膜弁，咽頭弁，頬粘膜弁との併用で再建できる．しかし，上壁と側壁に及ぶ欠損

では，外側からの咽頭弁により後鼻孔を狭くした後に，前腕皮弁や前外側大腿皮弁で被覆する．また，舌根や下顎骨が合併切除されている症例では腹直筋皮弁を選択する．後壁の欠損には，空腸を第1選択とする．前壁に限局した欠損では，1次縫縮の方が皮弁を移植するより術後機能が良い傾向がある．

●**下歯肉・頬粘膜・口腔底欠損**　基本的に薄くしなやかな皮弁が選択される．前腕皮弁，前外側大腿皮弁，大胸筋皮弁，空腸パッチなどが適応となる．下歯肉癌や口腔底癌で，下顎骨区域切除症例には腓骨皮弁や皮弁にプレートを併用した方法が選択される．

●**下咽頭・頸部食道欠損**　咽頭喉頭頸部食道欠損の場合には，瘻孔などの術後の合併症を考慮すると空腸が第1選択となる．その場合，可能な限り直線的に空腸を移植した方が術後の通過障害が少ない．実際の移植では咽頭空腸吻合を施行後に，用手的に空腸を下方に牽引した状態で，空腸食道吻合をするとよい．

■術中管理

遊離皮弁を選択した場合には，切除側と同時進行で皮弁の挙上を開始する．移植床の血管確保は重要で，特に根本的頸部郭清の場合には，内頸静脈系が温存されないため，外頸静脈系を温存するように努める．動脈に関しては，顔面，舌，上甲状腺，浅頸動脈などがあり，位置的には上甲状腺動脈が最も血管吻合がしやすい．皮弁の縫着と血管吻合の順番はどちらでもよいが，縫着時の自由度を考えると，皮弁の縫着後に血管吻合をした方が簡便である．しかし，血管柄が短く吻合部の設定が悪い場合や，皮弁の阻血時間が長い場合には先に血管吻合を施行する．皮弁の縫着のさいに，編み糸を使用すると術後に縫合糸膿瘍を引き起こすことが多い．基本的には3-0，4-0のモノフィラメント吸収糸がよい．

有茎皮弁を選択した場合には，皮弁自体並びに血管柄に余裕をもたせて移植することが重要である．腫瘍の切除と頸部郭清後に生じた顎下部の死腔を充塡することは，術後の瘻孔予防のために重要である．そこで，皮弁の皮膚成分と一緒に採取した腹直筋や外側広筋，大胸筋などの筋体を利用し充塡する．術後の創部血腫は感染につながるために，入念な止血と多数のドレーンを入れるのがよい．

気管切開術は，術後の嚥下運動の支障となるため基本的には避け，術当日は経鼻挿管のままとし，術後1日目に喉頭周辺の浮腫を確認しながら抜管する．ただし，舌全摘に近い症例，口腔底癌切除後，両側頸部郭清後などでは，気管切開が必要になることが多い．

■術後管理

高齢者が多く手術時間も長いため，入念な術後の全身管理が必要である．また，早期離床も重要で術後3日目には坐位をとらせ，可能であればその翌日から軽い歩行を開始する．術後は2週間ほど経鼻経管栄養となる．術後の創部感染は，瘻孔形成や皮弁の壊死を拡大し治癒を遷延させる．したがって，感染の兆候である発赤，腫脹，疼痛，そして術後4日目以降の発熱に注意し，その疑いがあれば積極的に創部のドレナージと洗浄を行う．

遊離皮弁の場合に重要な点は，吻合血管の血栓の早期発見である．皮弁が外部に出ている場合には，肉眼でその色調を確認する．口腔内の皮弁の色調は判断しにくいことがあるので，針で皮弁の真皮下層を刺し，出血するまでの時間と色を観察する．血栓形成の時期は，術後24時間以内が最も多く，疑われたときには速やかに開創し血栓除去を行う．

4. 舌・口腔・咽頭再建

4.1 はじめに

近年における再建手技の進歩により、身体さまざまな領域の組織修復が可能になってきた。そして、その再建目的も徐々に変わりつつある。従来の再建目的は、生じた組織欠損を自家組織などで充填または被覆することであった。しかしながら、最近ではより術後の機能・形態を重視した再建に焦点が移ってきている。その最たる領域が、摂食・会話機能に関与してくる頭頸部領域の再建である。そこには、単に組織を移植するのみならず、いかに良い術後機能を維持するかが求められ、同時にそれは切除範囲に応じた再建方法の改良・開発の必要性に関連してくる。本稿では、口腔咽頭領域における切除範囲に応じた適切な再建方法について述べるが、領域が複雑なため舌および中咽頭上側壁欠損の再建について記述する。なお、再建材料に関しては手術時間の短縮を目指し、遊離皮弁で腫瘍切除と同時に皮弁の採取が可能な部位のみを選択した。

4.2 舌再建

舌悪性腫瘍切除後の再建目的は、喉頭の温存のみならず、いかに良い摂食会話機能を維持するかである[1]。そして、その再建方法は舌の切除範囲で異なってくる。まず、舌の切除範囲は大きく6型に分類される(図3.4.1)。すなわち、可動部舌部切、可動部舌半切、舌半切(可動部舌半切ならびに舌根半切)、可動部舌亜全摘(舌根は温存され可動部舌が半分以上切除)、舌亜全摘(舌根ならびに可動部舌が半分以上切除)、舌全摘(舌根ならびに可動部舌が両側舌下神経を含めて全て切除)である。どの切除範囲でも同様であるが、頸部郭清と腫瘍が一塊として切除されることが多く、再建の目的は口腔と頸部の遮断と残存舌の可動域の維持である。

可動部舌部切では、一次縫縮が可能であり再建を要することはまずない。可動部舌半切の再建は、患側の舌骨上筋群が温存されていれば口腔内の再建の必要性はなく、舌はそのまま縫縮する。そして顎下部の死腔には顎二腹筋や胸鎖乳突筋などの充填を要する(図3.4.2)[2]。患側舌骨上筋群が合併切除された場合は、頸部との交通が大きくなり、口腔内に皮弁の移植と顎下部の死腔充填が必要となる。これは舌半切除と同様の術式となる。

舌半切と前述した再建を要する可動部舌半切の場合の再建方法であるが、残存舌尖に皮弁を逢着する方法と残存舌尖を縫縮して新しい舌尖を作成する方法がある。われわれは、どんなに軽い皮弁でもそれを残存舌に縫い付けると舌尖の動きが悪くなることを経験している。移植組織が動かない限りは残存舌を縫縮して舌

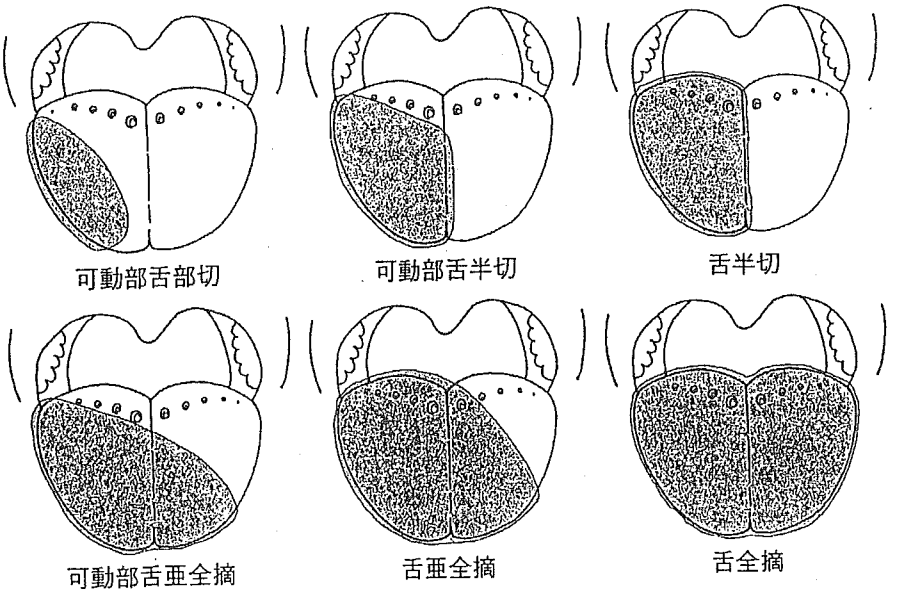

図3.4.1　舌切除範囲の分類

尖を作成し、その裏面から健側口腔底にかけて皮弁を挿入することで瘢痕拘縮を予防し、残存舌の動きが維持できるようにしている（図3.4.3）。さて、皮弁の選択であるが、薄い皮弁が望ましく前腕皮弁、前外側大腿皮弁[3]、そして薄い腹直筋皮弁（厚さ1cm程度）が考えられる[4]。その際、顎下部の死腔充填に脱上皮した皮膚成分、脂肪、そして皮弁に筋肉を母指大ほどつけて移植する方法がある。先の2者では瘻孔を形成したときの治癒期間が長くなる。われわれは皮弁採取部の多少の犠牲はあっても筋肉による顎下部充填が最も安全と考えている。

舌根を含まない可動部舌亜全摘には、外側広筋を付着させた前外側大腿皮弁や腹直筋皮弁が第一選択となる。この場合、移植した皮弁の容量が少ないと再建舌が陥凹して食塊の貯留が起きる。また舌尖音が出にくくなり、スピーチエイドなどの補助装具が必要となる。従って、移植皮弁の幅を十分にとり、隆起型の再建舌になるように心掛ける。舌尖形成に関しては、残存した舌組織の末梢が細長い形状であれば可能であるが、ほとんどの症例では不可能なため、そのまま皮弁を逢着することが多い。舌根が残っているために、後述する術後の喉頭の下垂を防止する必要性はない。

舌亜全摘・全摘術後の再建方法は、喉頭の温存のみならず摂食・会話機能に大きく関与してくるために、さまざまな工夫を要する。皮弁により再建された舌の形態は隆起型、半隆起型、平坦型、陥凹型に分類され（図3.4.4）、嚥下圧や口蓋音などの術後の機能を考慮すると再建舌が口蓋に接する隆起型の再建が最も望ましい[1,6]。そして、口狭部が狭い隆起型の再建舌を形成するための注意点として、容量のある皮弁（厚さが2cm以上）を選択すること、術後の喉頭下垂を予防することが挙げられる。結果として腹直筋皮弁が第一選択となる。そのデザインは最も皮下脂肪が厚くかつ穿通枝が多い臍周囲を中心とする。経験上、舌根に相当する部分の幅は最低でも8～9cmは必要で、皮下脂肪も2～3cm位は必要である。皮弁のデザインと挙上は、一般的に紡錘型とする場合が多い。舌全摘ならば皮弁は紡錘型で良いが、舌根などの残存組織が多い場合に紡錘型の皮弁をそのまま縫着すると、皮弁が捻れたり大きすぎたりすることがよくある。この場合、舌全摘の紡錘型のテンプレートをイメージし挙上後に、残存舌の表面積だけ皮弁を除去する方が簡便で良い（図3.4.5）。顎下部の死腔の充填目的に使用する腹直筋の筋体は必ずしも全幅必要でなく、1/3～1/2幅で十分である。皮弁の縫着は喉頭蓋谷から縫着を開始し、粘膜並びに皮膚が咽頭腔に内翻するように縫合を行う。そして、口腔内に移り皮弁を歯肉粘膜に縫合する。顎下部には筋体を充填した後に、頸部で血管吻合をする。

最後に、喉頭下垂防止術を付け加える。下顎骨正中から1～2cm程度外側にドリルで2ヵ所ずつ孔を開け、7号ナイロンまたは鋼線で舌骨を吊り上げる。舌骨上縁と下顎下縁との距離は2cm程度とする[6]。気管切開術に関しては、舌半切では必要ないが舌全摘に近いほど必要になることが多い。

隆起型を呈していても、あまり良い術後機能が得ら

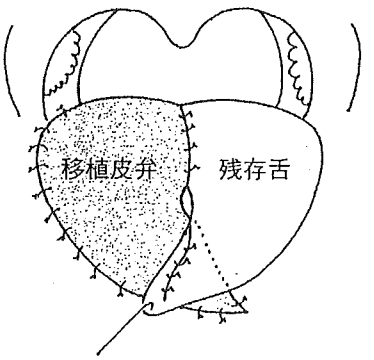

図3.4.3　舌半切、舌尖縫縮

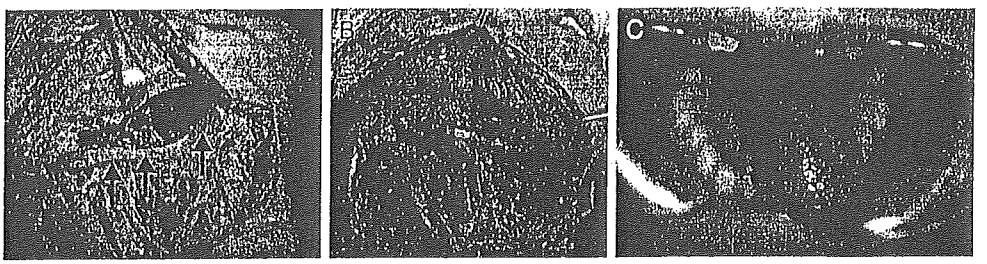

図3.4.2　可動部舌半切症例
A：顎部郭清後の顎下部死腔の状態。顎二腹筋（矢印）。
B：顎二腹筋を広頸筋と縫合し、口腔と頸部を遮断。
C：術後の残存舌の状態。良好な可動域が得られている。

れない症例もある。その理由として術前状態、合併切除範囲、嚥下機能、患者の社会復帰に対する意欲などが関与してくる。術前状態として、アルコール性脳障害や脳梗塞などの神経的疾患がある症例では、喉頭温存は困難である。合併切除範囲では、舌全摘術に加え喉頭蓋までの切除または下顎や中咽頭が半分以上切除された症例では機能の損失が大きく、やはり喉頭の温存を目指した再建は困難である[6]。年齢に伴う嚥下機能の評価は確立された方法がなく、難しい問題であるが、若い人ほど良く、70歳以上になると喉頭温存の可能性がかなり低くなる。

4.3　中咽頭切除後の再建

中咽頭癌切除後の再建でよく遭遇するのは、側壁を中心とした欠損である。そして、この部分の組織欠損に対する再建の目的は、鼻咽腔閉鎖機能と鼻呼吸の維持の大きく二つである。また、移植皮弁と残存した軟口蓋や硬口蓋の断端との縫合部に哆開を生じると、術

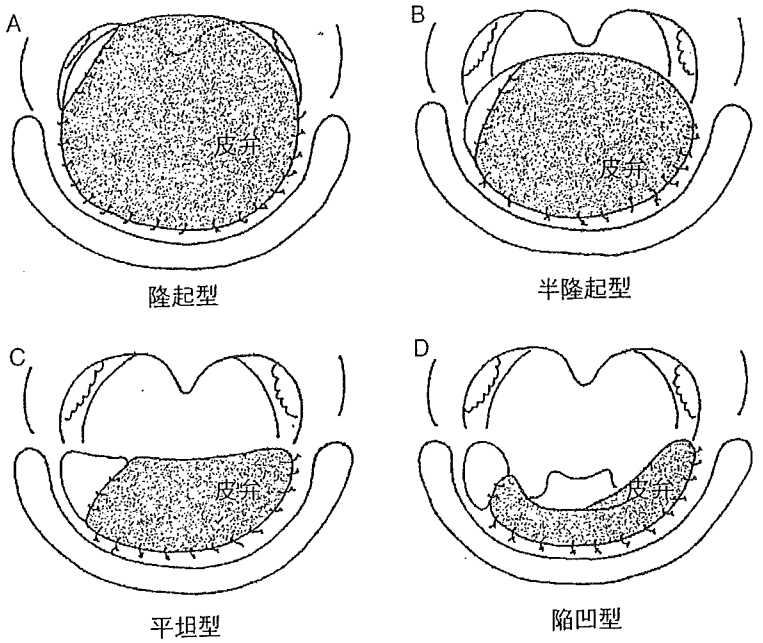

図 3.4.4　再建舌の形態分類
A：隆起型。皮弁は口蓋に接し、開口時に口狭部が見えない。
B：半隆起型。隆起しているが、口狭部が見える。
C：平坦型。移植皮弁が平坦状で、口狭部が広い。
D：陥凹型。移植皮弁は陥凹している。時に喉頭蓋が見える。

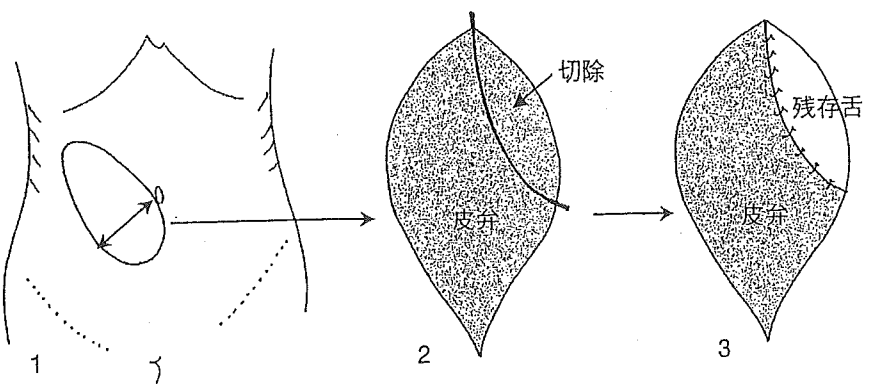

図 3.4.5　腹直筋皮弁の採取部位とテンプレート法
1：皮下脂肪の厚い部分（矢印）で舌根を再建。
2：全摘のデザインで紡錘型に皮弁を採取し、残存舌に相当する部分は切除する。
3：残存舌と移植皮弁を縫合する。

後の鼻咽腔閉鎖不全、開鼻声につながる。従って、咯開しないような皮弁の縫着方法が必要になる。また、舌再建と同様に欠損範囲を分類し、それに対応した再建方法が必要になる。

中咽頭側壁中心の切除範囲は、大きく3型に分類される。側壁欠損、側壁・上壁欠損、側壁・舌欠損である（図3.4.6）[7,8]。側壁欠損に対する再建は、前腕皮弁や前外側大腿皮弁、そして腹直筋穿通枝皮弁（厚さ1 cm程度）を用いて、単なるパッチ状移植で機能は十分に温存される。その際、顎下部の死腔（母指大ほどの容量）の充填に脂肪組織、できれば筋肉組織で充填できると術後の局所合併症が少ない。

問題なのが、側壁・上壁欠損である。咽頭後壁が半分以上残存している場合には、Gehannoら[9]が報告した後壁の咽頭粘膜弁を翻転して残存軟口蓋断端に縫合する方法を選択する（Gehanno法）（図3.4.7上段）。これにより鼻咽腔を狭小化する。放射線照射後の症例や上壁または後壁の切除範囲が大きい時には、より縫合部に緊張がかかる。この場合には、剥離した咽頭弁の外下方にback-cutを入れると良い[10]。最後に、皮弁をパッチ状に移植する。硬口蓋まで上壁が切除されている場合には、前述した咽頭粘膜弁を翻転して鼻咽腔を完全に塞ぐことができず、硬口蓋側が一部開いた状態になる。このまま皮弁を移植すると、鼻咽腔側に上皮が欠損する部分が生じるが、術後に咯開などの合併症を生じたことはない。

さて、後壁が半分以上切除されている場合には、前述の方法で鼻咽腔を再建するのは不可能である。この場合には、皮弁の一部を折りたたみ残存軟口蓋に相当する部分を脱上皮して、皮弁を縫着するDenude法を

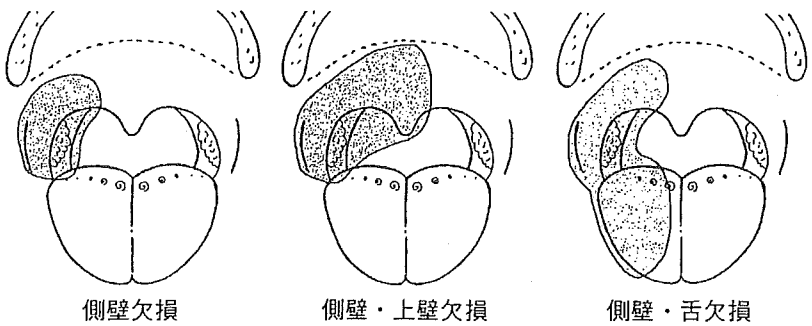

図3.4.6　中咽頭側壁中心欠損の分類

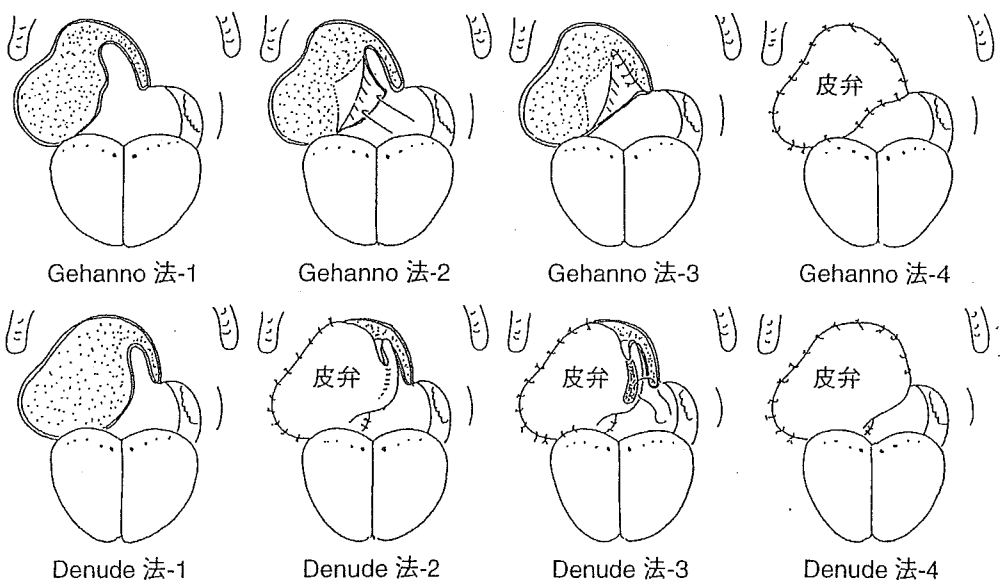

図3.4.7　中咽頭側壁・上壁欠損再建方法
上段：Gehanno法による再建。残存咽頭後壁粘膜を翻転して、残存軟口蓋と縫合する。
下段：Denude法による再建。皮弁を二つ折りにして欠損に縫着し、残存軟口蓋と縫合予定部分を脱上皮する。

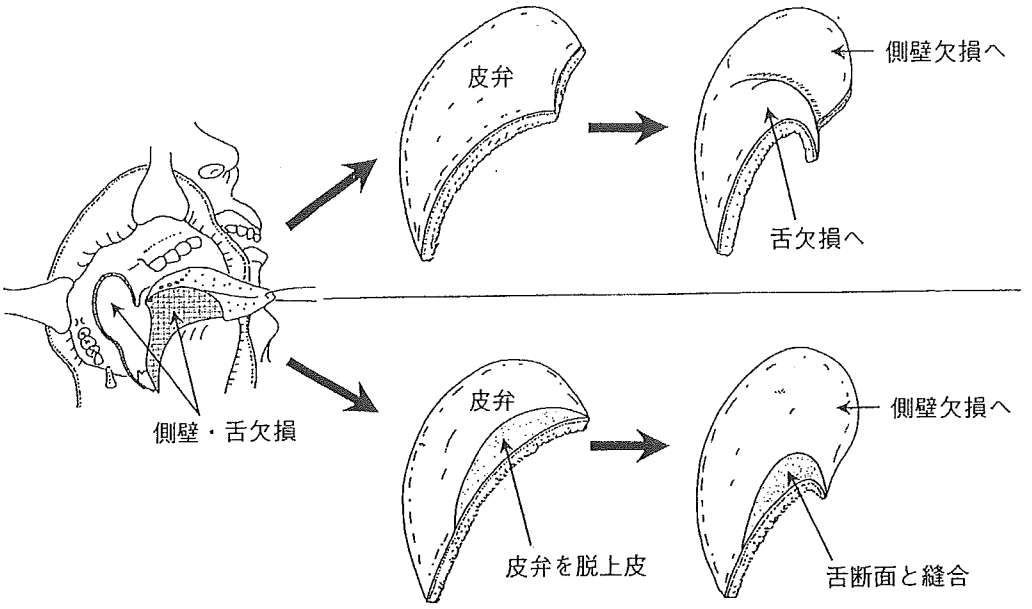

図 3.4.8　中咽頭側壁・舌欠損再建方法
上段：皮弁を二つ折りにして、側壁と舌欠損を再建。
下段：皮弁の一部を脱上皮して、舌断面と縫合。

選択する（図 3.4.7 下段）[8]。これは、皮弁の容量自体で鼻咽腔を狭小化する方法であるが、皮弁の脱上皮した部分と残存軟口蓋断端との縫合部を哆開しやすい。従って、3 層に密に縫合する。以上の縫着方法に伴い皮弁を選択し、移植することになる。鼻呼吸が可能な最小の鼻咽腔の広さは小指頭大の太さ、または 14 Fr 位までとの報告がある[11]。従って、Gehanno 法ならば上壁が 1/3 以上かつ後壁が 1/2 以上残存している症例、Denude 法ならば上壁後壁ともに 1/3 以上残存している症例に対し再建可能である。逆に、それ以上の欠損で鼻咽腔と鼻呼吸機能の両方を温存することは不可能で、現段階では再建の限界と考えている。皮弁の選択であるが、Gehanno 法であれば、前腕皮弁、前外側大腿皮弁、腹直筋皮弁（厚さ 1 cm 程度）が適応に、Denude 法であれば、厚みのある腹直筋皮弁が適応と考えている。

舌癌の中咽頭側壁進展、または中咽頭側壁癌の舌根、可動部舌進展の際には、側壁・舌欠損の形態となる。中咽頭側の欠損は広範囲になることは少ないため、Gehanno 法で対応できることが多い。しかし、中咽頭側壁から上壁の面と舌の面とは空間的に異なるため、工夫を要する。ここで重要なのは残存舌の動きを維持すること、食塊が健側を通過するようにして（知覚のある側から）誤嚥を失くすことである。現在、二通りの皮弁の縫着方法を試みている。一つは皮弁をすり鉢の 1/3 周状に移植し、中咽頭と舌を再建する方法（図 3.4.8 上段）がある。この方法はイメージがつきやすく簡便であるが、再建した中咽頭上壁と再建舌の間で皮弁が折れることにより溝ができ、食塊が患側を通りやすくなるという欠点がある。もう一つの方法は、口腔内の中央に衝立を立てるように皮弁を移植し、残存舌断面に相当する部分の皮弁を脱上皮し移植する（図 3.4.8 下段）。この方法は、食塊がほとんど健側を流れるために誤嚥を生じにくいが、脱上皮する部分が大きいと残存舌の動きが悪くなる。従って、どちらの方法にも利点と欠点がある。現在は、可動部舌を大きく切除された場合には前者を、舌根部分切除程度の合併切除では後者を選択しているが、今後の検討を要する領域である。

4.4　最後に

今回記述した再建方法は、外科治療が主体の組織欠損である。従って、放射線、化学療法が先行している場合、また術後に放射線治療をした場合には、良好な機能が維持できなくなる可能性もある。癌を制御するのは勿論のこと、術後機能にも十分に考慮して、治療方針を選択すべきである。一方、口腔咽頭領域には、舌根、頬粘膜、口腔底、歯肉などまだまだ記述すべき部分があるが、今回は舌・中咽頭側壁を中心に述べさせていただいた。

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Analytic Review of 2372 Free Flap Transfers for Head and Neck Reconstruction Following Cancer Resection

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ABSTRACT

Microvascular free tissue transfer has gained world-wide acceptance as a means of reconstructing post-oncologic surgical defects in the head and neck region. Since 1977, the authors have introduced this reconstructive procedure to head and neck reconstruction after cancer ablation, and a total of 2372 free flaps were transferred in 2301 patients during a period of over 23 years. The most frequently used flap was the rectus abdominis flap (784 flaps: 33.1 percent), followed by the jejunum (644 flaps: 27.2 percent) and the forearm flap (384 flaps: 16.2 percent). In the reported series, total and partial flap necrosis accounted for 4.2 percent and 2.5 percent of cases, respectively. There was a significant statistical difference ($p < 0.05$) in complete flap survival rate between immediate and secondary reconstruction cases. The authors believe that the above-mentioned three flaps have been a major part of the armamentarium for head and neck reconstruction because of a lower rate of flap necrosis, compared to other flaps.

KEYWORDS: Head and neck reconstruction, free flaps, post-oncologic defects, complications

The jejunum was the first auto-transplanted tissue that was transferred heterotopically in the human, using small vessel anastomotic techniques. In 1957, Seidenberg et al.[1] performed immediate reconstruction of the cervical esophagus by a revascularized jejunal segment. Although this patient died on the seventh postoperative day following a cerebral vascular accident, the vascular anastomoses were shown patent at autopsy. In 1961, Roberts et al.[2] reported successfully transferred clinical cases with this procedure. Since then, the free jejunal transfer has become part of the standard armamentarium for pharyngo-esophageal reconstruction following cancer resection because of low complication rates and less donor-site morbidity.[3,4]

The transfer of a skin flap had not been successfully performed clinically until Harii et al.[5] transferred a free scalp flap in September, 1972. Successful reports followed from Daniel and Taylor[6] (1973) and O'Brien et al.[7] (1973). To our knowledge, the first free skin flap transfer to the intra-oral cavity was reported by Kaplan and colleagues,[8] although the transferred groin flap was extruded more than 3 weeks postoperatively. In the very early days, the groin flap and the deltopectoral flap were the most frequently used skin flaps, and the results were not always

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acceptable. However, in the late 1970's, various kinds of free flaps were exploited and since then, many authors have reported successful transfer of free flaps for head and neck reconstruction after cancer ablation.[9–13]

Although many years have passed since the first introduction of this technique in head and neck reconstruction, long-term experience spanning more than 20 years has not been reported previously. Therefore, we reviewed our large series of free flap reconstruction in this area in cancer patients to document the average success rate of the mainly used flaps. We also analyzed the causes of failure and the factors that might affect thrombosis rates. The frequency of free flap failures are analyzed with respect to patient's age, donor site, and whether the procedure was done for a primary or secondary reconstruction.

We believe that the outcome in such a large series, operated on not by a few well-experienced microsurgeons but by many plastic and reconstructive surgeons at various levels, shows the true reliability and efficacy of free flap reconstruction in the head and neck region.

PATIENTS AND METHODS

During the period from November, 1977 to December, 2000, a total of 3318 patients received free flap transfer to reconstruct various kinds of defects at the University of Tokyo Hospital, the National Cancer Center Hospital, and the affiliated hospitals of the University of Tokyo. Among them, 2301 patients (69.3 percent) underwent 2372 free flap transfers for head and neck reconstruction after cancer ablation. These reconstructive procedures were performed by many plastic surgeons, ranging from experienced senior staff to relatively inexperienced junior staff. The patients' charts were reviewed retrospectively from the database catalogued in a microcomputer (Microsoft, Access data).

There were 1716 males and 585 females, whose ages range from 5 to 88 years (mean: 57.9 years). The ratio of the patients over 70 years old was 17.8 percent (409 patients) in this series. Immediate reconstruction following cancer ablation was performed in 2039 cases (88.6 percent) and secondary reconstruction for functional and/or aesthetic improvement after cancer removal in 262 cases (11.4 percent).

In 48 cases, two free flaps were used simultaneously for large and/or complex tissue defects. This dual free flap transfer was useful, especially for complex mandibular and maxillary reconstructions, as we have previously reported.[14] In 23 cases, a second free flap transfer was carried out to salvage the patient shortly (within 1 month) after failure of a first free flap transfer.

As a whole, the most frequently used flap was the rectus abdominis flap (784 flaps: 33.1 percent), followed by the jejunum (644 flaps: 27.2 percent), and the forearm flap (384 flaps: 16.2 percent) (Table 1).

In immediate reconstruction, the donor flaps used mainly were the rectus abdominis (749), jejunum (612), forearm (340), thigh (140), and latissimus dorsi (64). Transferred regions were as follows: oral cavity (739), hypopharynx and/or cervical esophagus (694), oropharynx (255), mandible (136), maxilla (91), and others (124).

In secondary reconstruction, the donor sites included the latissimus dorsi (45) and forearm (44), followed by the scapula (37), rectus abdominis (35), and jejunum (32). Flaps were transferred to reconstruct maxilla (53), mandible (49), hypopharynx and/or cervical esophagus (47), orbit (44), facial palsy (27), and others (42).

The recipient vessels used for anastomoses varied. The most commonly used artery was the superior thyroid artery (1306), followed by the superficial cervical artery (454), and facial artery (344). The internal jugular vein (865) was the most commonly used vein, followed by the facial vein (717), and external jugular vein (519). End-to-side anastomosis was performed when using the external carotid artery as a recipient artery (10), and the internal jugular vein (860), the external jugular vein (8), the common facial vein (4), and the brachiocephalic vein (1) as a recipient vein.

Intra- or postoperative pharmacologic manipulation was not standardized for these long periods, but

Table 1 Number of Free Flaps Used for Reconstruction

Flap	Total	Immediate Reconstruction	Secondary Reconstruction
Rectus abdominis	784	749	35
Jejunum	644	612	32
Forearm	384	340	44
Thigh	148	140	8
Latissimus dorsi	109	64	45
Scapular	86	50	36
Iliac	44	29	15
Fibular	54	38	16
Groin	26	4	22
Others	93	63	30
Total	2372	2089	283

recently in many cases, prostaglandin E1 was administered postoperatively for several days. Postoperative monitoring was performed with clinical observation, pinprick testing, and/or conventional Doppler ultrasonography as a routine procedure in all possible cases.

The statistical analysis was performed using χ^2 analysis or logistic regression analysis. A p value of 0.05 or less was defined as statistically significant.

RESULTS

In our series, total flap necrosis occurred in 100 flaps (4.2 percent), partial flap necrosis occurred in 60 flaps (2.5 percent), resulting in a complete flap survival rate of 93.3 percent. In elderly patients over 70 years of age, the total flap necrosis rate was 3.1 percent, partial necrosis 2.7 percent, and therefore the complete survival rate was 94.2 percent. The causes of free flap failure are summarized in Table 2. In the case of total flap necrosis, arterial thrombosis was the most common cause, followed by venous thrombosis, and postoperative infection. In partial flap necrosis, technical errors and/or anatomic variations in flap elevation were the main cause, followed by infection and arterial thrombosis.

Complete survival rates of the commonly used flaps were 93.3 percent for the rectus, 96.9 percent for jejunum, and 95.8 percent for the forearm. Compared to these flaps, other less frequently used flaps had a lower survival rate that was statistically significant (Table 3). Osseous or osteocutaneous flaps, including the iliac bone, had the lowest complete survival rate.

In cases of immediate reconstruction, we obtained a 93.9 percent complete survival rate, compared to 88.7 percent in secondary reconstructions. There was a significant statistical difference ($p < 0.05$) between these two groups in the rate of complete flap survival (Table 4).

The rate of thrombosis was 4.0 percent (96 flaps) in the whole series, with no statistically significant difference between arterial and venous thrombosis. The rate for elderly patients over 70 years was 4.1 percent (17/414). We analyzed the salvage rate of free flaps when re-exploration was performed following detection of thrombosis at the anastomotic site. Arterial thrombosis was detected in 46 cases and venous thrombosis in 50 cases.

Table 2 Causes of Free Flap Failure

	Total Necrosis	Partial Necrosis
Arterial thrombosis	36	7
Venous thrombosis	28	4
Infection	18	11
Anomaly in vascular pedicle	8	4
Problems in flap elevation	6	29
Miscellaneous	4	5
Total	100	60

Table 3 Complete Survival Rate of Each Flap

	Complete Survival	Total Necrosis	Partial Necrosis
Rectus abdominis	93.3%	3.6%	3.1%
Jejunum	96.9%	3.1%	0%
Forearm	95.8%	2.6%	1.6%
Thigh	90.5%	7.4%	2.0%
Latissimus dorsi	85.3%	3.7%	11.0%
Scapular	91.9%	4.7%	3.5%
Iliac	79.5%	15.9%	4.5%
Fibular	81.5%	11.1%	7.4%
Three major flaps (rectus, jejunum, forearm: n=1812)	95.1%*	3.2%	1.7%
Three major osseous or osteocutaneous flaps (ilium, fibula, scapula: n=170)	84.7%*	10.0%	5.3%

(*$p < 0.05$)

In the former group, although thrombectomy was done in 20 cases, only three flaps (15.0 percent) survived completely. In the remaining 26 cases, thrombectomy was not feasible due to delay in re-exploration, and no complete survival was obtained. In contrast, removal of venous thrombus was carried out in 30 cases, of which 18 cases (60.0 percent) had complete flap survival. Of 20 cases that did not have a thrombectomy, only one flap survived completely (Table 5).

The rates of thrombosis in the commonly used recipient vessels were compared. There was no significant statistical difference between these vessels (Table 6).

The time when postoperative thrombosis was detected was also analyzed in the patients operated on between 1990 and 2000. Seventy-six patients had circulatory disturbance of the transferred flap due to thrombosis at the anastomotic site in this period. Arterial and venous thrombosis occurred in 38 cases each. In about 80 percent of cases in both groups, thrombosis developed within 3 days after surgery (Table 7).

In our series, a total of 390 patients (17.0 percent) had postoperative complications. Complications other

Table 4 Comparison Between Immediate and Secondary Reconstruction in Flap Survival

	Complete Survival	Total Necrosis	Partial Necrosis
Immediate (2089 flaps)	93.9%*	3.8%	2.3%
Secondary (283 flaps)	88.7%*	7.4%	3.9%

(*$p<0.05$)

Table 5 Salvage Rate by Exploration in Thrombosis Cases

	Complete Survival	Partial Necrosis	Total Necrosis
Arterial thrombosis: n=46			
Thrombectomy(+) n=20	3 (15.0%)	5 (25.0%)	12 (60.0%)
Thrombectomy(−) n=26	0	2 (7.7%)	24 (92.3%)
Venous thrombosis: n=50			
Thrombectomy(+) n=30	18 (60.0%)	2 (6.7%)	10 (33.3%)
Thrombectomy(−) n=20	1 (5.0%)	2 (10%)	17 (85%)

than flap necrosis and thrombus formation are listed in Table 8.

DISCUSSION

Free tissue transfer using microvascular anastomosis has established its position as one of the principal reconstructive procedures in the head and neck region. Although there have been several reports on large series of head and neck reconstructions with free tissue transfer,[9,11–13] most of them were performed by a few well-experienced microsurgeons for a limited period. Our data are based on the results of a long period of more than 20 years, since the first consecutive application of free tissue transfer in this region in Japan. In addition, many plastic and reconstructive surgeons, from those with extensive experience to young relatively inexperienced surgeons, have performed these reconstructive procedures during this long period. Nevertheless, the total necrosis rate in our series is 4.2 percent and compares favorably with other reports.

As for the complete flap survival rate, the three major flaps (the rectus, forearm, and jejunum) fared better than other flaps. These flaps have a longer vascular pedicle of a large caliber, and anatomic variations are very rare, facilitating easy harvest. Conversely, osseous or osteocutaneous flaps, such as the fibula and iliac flaps, had a lower survival rate. Kroll et al.[15] also reported a higher failure rate for osteocutaneous flaps, compared to free soft tissue transfers. A bony defect is usually three-dimensionally complex and requires sufficient soft and hard tissue to reshape the defect and fill the dead space. In addition, the cutaneous portion of the iliac osteocutaneous flap is recognized as having an unreliable vascular supply. The fibular flap includes only a thin skin paddle that is often insufficient for reconstruction of large soft tissue defects, and it has a vascular pedicle that frequently includes vessels of a very large diameter, demonstrating a remarkable discrepancy with recipient neck vessels.

Comparison of flap survival rates between immediate and secondary reconstruction cases shows a statistically significant difference ($p < 0.05$, see Table 4). In secondary reconstruction, the available recipient vessels are usually limited, due to scar formation from previous surgery and/or irradiation. These factors also lead to delayed wound healing and an increased risk of infection.

Thrombosis developed in 4.0 percent of cases in our series. In the same period, we transferred 188 flaps to reconstruct defects in the lower extremities, and thrombosis formation occurred in 37 cases (19.7 percent). A statistically significant difference exists between these two regions in the thrombus formation rate. In the head and neck region, there are usually several available recipient vessels, and a recipient artery, which is often a branch of the external carotid artery, often has good pulsatile flow and strong pressure. In addition, the internal or external jugular veins and their branches have a nega-

Table 6 Thrombosis Rates in Commonly Used Recipient Vessels

Artery		Vein	
Superior thyroid	1.8% (23/1306)	Internal jugular	2.0% (17/865)
Superficial cervical	1.8% (8/454)	Facial	2.0% (14/717)
Facial	3.2% (11/344)	External jugular	2.7% (14/519)
Lingual	0.9% (1/106)	Superior thyroid	3.5% (3/85)
Superficial temporal	1.4% (1/69)	Superficial temporal	1.5% (1/66)